Ministry of Education,
Youth and Sport
of the Czech Republic

Analysis of previous trends and existing state of research and development in the Czech Republic and a comparison with the situation abroad

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In January 2002, the Government by its Resolution No. 16 adopted the National Research and Development Policy of the Czech Republic. Detailed analysis of the previous trends and existing state of research and development in the Czech Republic and comparison with the situation abroad preceded the preparation of this fundamental conceptual document. The analysis was approved by the Government in June 1999 by its Resolution No. 563.

The Government, while approving the National Research and Development Policy of the Czech Republic at thebeginning of 2000, simultaneously formulated several tasks through the implementation of which the system of research and development in the Czech Republic should have further approximated to the systems in EU member states. Due to the envisaged changes of both internal and external conditions of the trends of research and development, the policy was stipulated for a period of two or three years, considering that after this time the policy shall be updated or a new policy shall be formulated.

The development certified this assumption. By adopting the Act on state support of research and development and on amendment of certain related acts (Act No. 130/2000 Coll.) the legal framework of research and development changed substantially. Further, the interconnections between the research and development (R&D) in the Czech Republic and in the European Union were strengthened. The Czech Republic took an active part in the process of creation and development of the European Research Area. It was decided that the Ministry of Education, Youth and Sport, in co-operation with the Research and Development Council of the Government of the Czech Republic, should submit to the Government the new National Research and Development Policy of the Czech Republic for the period 2003 to 2008 in the first half of 2003. Like in 2000, a detailed and objective analysis of the previous trends and existing state of research and development in the Czech Republic and comparison with the situation abroad (hereinafter "analysis") should have preceded.

This analysis was drawn up by a working group consisting of the representatives of universities, the Academy of Sciences of the Czech Republic, industrial research and the ministries having the highest expenditure for research and development. The composition of the working group is referred to on the title side of the analysis. The analysis was presented to the Government following the debate. The Government approved the analysis on May 22, 2002 by its Resolution No. 516. At the same time, the Government decided to submit the proposal for the National Research and Development Policy of the Czech Republic for the period 2003 to 2008 based on the approved analysis to the Government until March 31, 2003.

The analysis approved in May 2002 is more detailed than the similar document of 1999. It is subdivided into nine basic parts A– J.

A. Analysis of OECD research and development statistics

Thirteen indicators based on OECD data – main Science and Technology Indicators 2001/1 were analysed. Czech Republic data are commented and compared with the data of a selected group of countries: Denmark, Finland, France, Japan, Hungary, Germany, Poland, Austria, Greece, United Kingdom, USA and the EU as a whole.

B. Analysis of state expenditures devoted to research and development in the Czech Republic

Four indicators based on the state budget data of the Czech Republic for the years 1993 to 2002 were analysed. The development of the overall state support of research and development as well as the development of the overall support, institutional support and of targeted support of selected institutions and ministries were assessed. The selected group is represented of: Academy of Sciences of the Czech Republic, Grant Agency of the Czech Republic, Ministry of Industry and Trade, Ministry of Education, Youth and Sport, Ministry of Health, Ministry of Agriculture and Ministry of Environment.

C. Analysis of information system data with regard to research and development (R&D IS)

Analysis in this field is based on data of three large databases of the Research and Development Council: Central Evidence of Projects (CEP) – analysed 7 indicators; Central Evidence of Research Plans (CEI) – analysed 5 indicators; Register of Research and Development Results (RIR). In this part of the analysis, the dimension of projects and amounts of research plans pursuant to the amount of financial means allotted to them, the age of the principal investigators and other interesting parameters are assessed.

D. Bibliometric analysis of R&D results

The bibliometric quality of publications in the Czech Republic is assessed in six or seven indicators and compared with the selected countries, based on the Web of Science ISI Thompson Scientific data. This part of analysis also includes a short methodological supplement.

E. Analysis of patents considered as outputs of research and development

Based on the data of the Industrial Property Office of the Czech Republic and OECD data – main Science and Technology Indicators 2002/1, six indicators are analysed. In case of selected indicators, the comparison with selected OECD countries is made.

F. Analysis of the output of applied research and development

In this part of the analysis, the envisaged and actual outputs of applied research and development projects which were completed in the period 1998–2001 were assessed. The projects which were the part of research and development programmes supervised and financed by the Ministry of Industry and Trade, Ministry of Defence, Ministry of Health, Ministry of Agriculture and Ministry of Environment were the focus of this part of the analysis. The main reasons why in some cases the envisaged results were not achieved are mentioned.

G. Economic performance related with research and development

This part of analysis is a simplified attempt to put the economic performance and competitiveness into the relation with the extent of research and development support and its standard. Data from various domestic and foreign sources are used. It is possible to conclude from this part that the increase of expenditures on research and development must be accompanied by the restructuring of economy.

H. Assessment of the fulfilment of the National Research and Development Policy of the Czech Republic

A detailed and matter-of-fact assessment of how the National Research and Development Policy adopted by the Government in January 2000 has been fulfilled is presented. The fulfilment of particular tasks imposed by the Government and the development of individual spheres of the Policy are assessed separately.

I. Overall assessment of the fulfilment of research and development conceptions in particular sectors in 2000

The Government, by means of its resolution by which it adopted the National Research and Development Policy of the Czech Republic in January 2000 imposed upon individual ministries and important institutions engaged in research and development to draw up their own sections conceptions of research and development in the context of the approved national policy. The analysis in this part assesses the fulfilment of conceptions and also deals with the reasons why these conceptions were possibly not fulfilled.

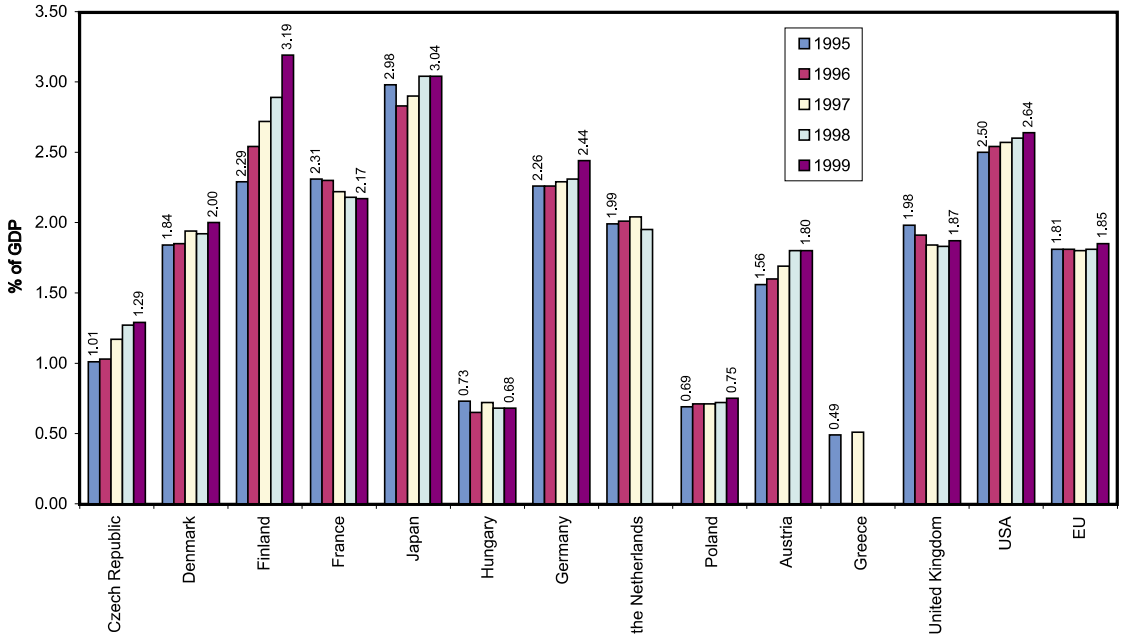
J. Assessment of research and development in the Czech Republic mentioned in foreign documents

In this section, important foreign documents which deal with the evaluation of research and development in the Czech Republic are shortly mentioned. These are mostly the EU documents drawn up either in the process of accession of the Czech Republic into the EU, or in the framework of benchmarking of research and development policies and innovative policies. This part is completed with certain standpoints referred to in part H. – Economic performance and research and development.

Complete analysis is available on the Internet on addresses: www.msmt.cz; www.vyzkum.cz. Likewise the previous analysis it is published in Czech and English versions.

A 1. Trend of total R&D expenditures

(total expenditures on research and development in per cent of GDP)



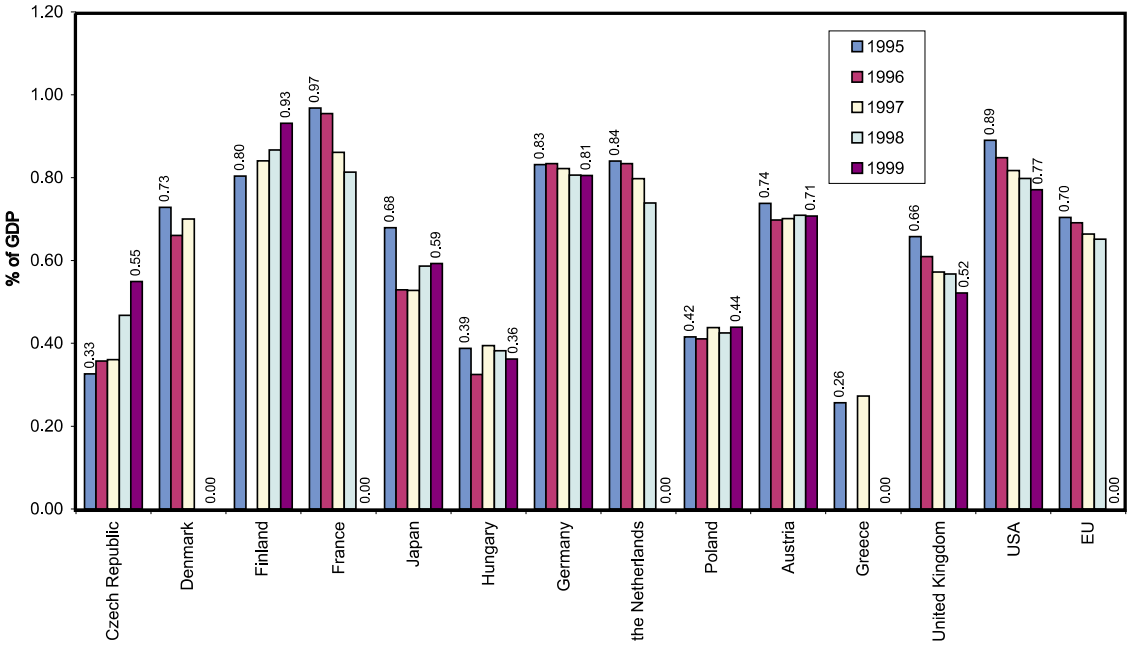
Source: OECD – Main Science and Technology Indicators 2002/1
Note: Numbers in the graph indicate the proportion in GDP of total expenditure on research and development respectively in the first and last year of the period in question. Incomplete columns for some countries indicate missing data.

Commentary

1. Developed countries spend 2 to 3 % of GDP on R&D, primarily to preserve their competitive edge, whereas some less developed OECD countries less than 1 %. Sweden, not included in the above selection, devotes the largest proportion of GDP to R&D – 3.6 %. The macroeconomic relationship between total R&D expenditures and GDP has its microeconomic analogy. Statistically more significant is still the correlation between expenditures of individual firms on R&D and their revenue/earnings. Expenditures of firms on R&D are analysed in detail in Chapter G: Economic Performance and R&D.
2. The slump in total R&D expenditures experienced in France and Great Britain was mostly due to the reduced demand for armaments after the end of the cold war. Disposable funds allocated to R&D in Germany decreased primarily because of massive subsidies granted to the new states, and currently are on the rise.
3. In contrast to the Czech Republic, indirect support extended to R&D (tax reliefs etc.) plays an important role in EU countries.
4. In 1989 expenditures devoted to R&D in the now defunct Czechoslovakia slumped (in 1991 expenditures adjusted for the Czech Republic alone amounted to 2.03 % of GDP). The decline continued in the Czech Republic at a somewhat more moderate pace till 1995 when expenditures devoted to R&D started to rise. In the period in question the trend of increasing total expenditures on R&D commenced. Hungary experienced a similar decline. This sharply contrasts with the rise in Finland, from a considerably higher base, which accompanied a deliberate and rapid transformation of the economy, strongly dependent on the Soviet market similarly as the Czech Republic and Hungary. Denmark and Austria also have exhibited a rising trend.

A 2. Trend of state expenditures on R&D

(state expenditures on research and development in per cent of GDP)



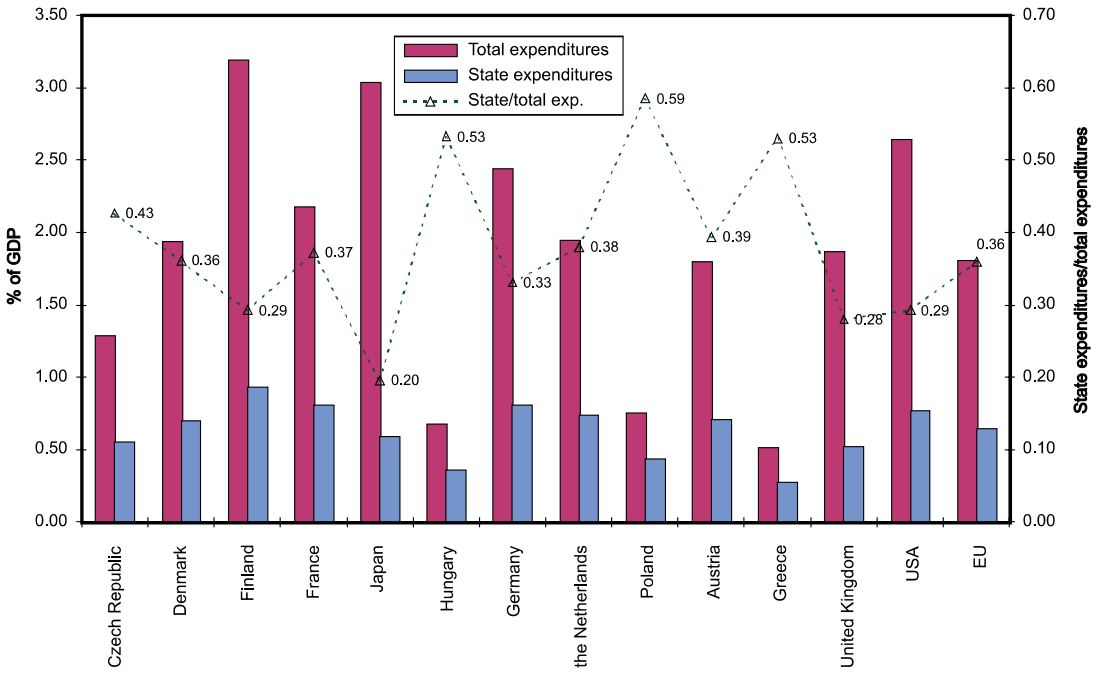
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Only federal expenditures are listed in case of Austria; similarly, only federal expenditures are shown for the USA and investment costs are not included; expenditures on social sciences are excluded in case of Japan. Missing columns for some countries indicate lack of primary data.

Commentary

1. The generally observed decline of state participation in R&D financing experienced in the first half of the 1990s has already been levelled off and in some countries has been replaced by a growth.
2. Among the listed countries, only Greece has devoted to R&D smaller proportion of the state budget than the Czech Republic. In Greece (and also Portugal, not included in the graph, for which a number of data items for recent years are lacking) state expenditures on R&D are distinctly smaller than what one would expect on the basis of the level of their economies, and the two countries have been reprimanded.
3. Chapter B, which analyses state expenditures on R&D in the Czech Republic, contains data higher than the figures shown in this Chapter A. Similar differences (app. 5–10 %) between data presented by statistical and financial authorities are common also in developed countries. In the Czech Republic the difference is however much higher – amounting to almost 25 % of state expenditures – and, what is more worrying still, tends to increase. The reason, except of poor discipline of organisations filling in statistical questionnaires, is probably insufficient capacity of departments that deal with R&D in the Czech Bureau of Statistics.
4. For the period in question – first half of the 1990s – particularly in the Czech Republic and Finland state participation of R&D financing substantially increases. Roughly constant state expenditures on R&D are reported e.g. in Germany, Austria, Hungary and Poland. The other countries exhibit apparent increase of state participation in R&D financing.

A 3. Comparison of total and state expenditures on R&D – 1999 data

(total and state expenditures on research and development in per cent of GDP, the ratio state/total expenditures)



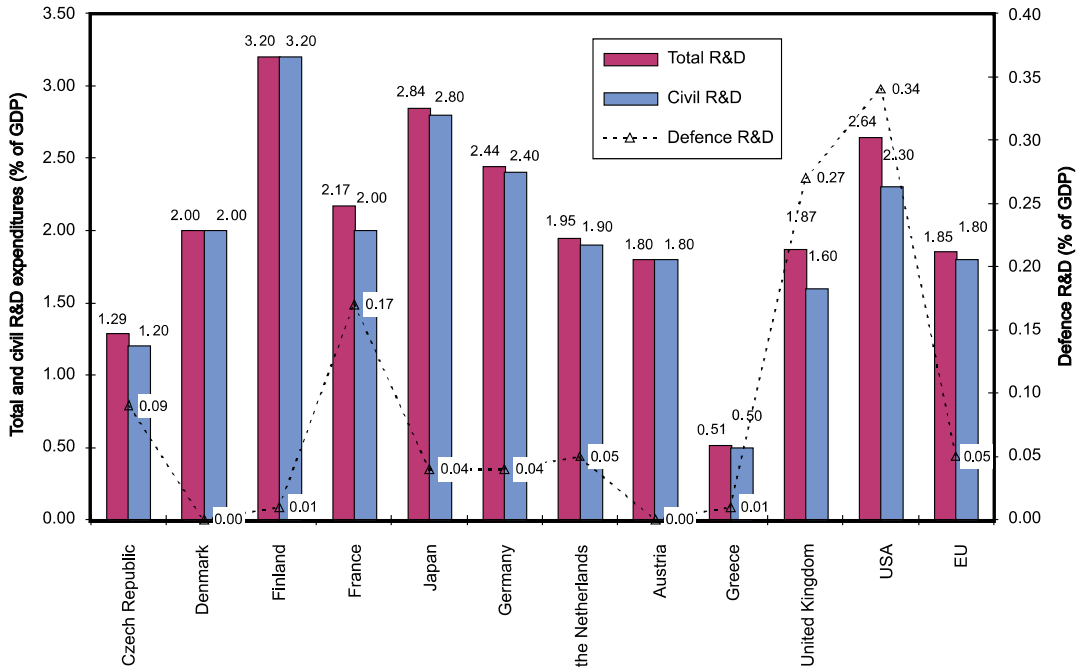
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Data for 1997 are listed for Denmark and Greece, while for France, the Netherlands and EU the last available data are for 1998.

Commentary

1. The comparison of total and state expenditures on R&D in 1999 shows that the state funds participate in R&D financing in 20–60 % of total expenditures on R&D. The largest proportion of state R&D financing exhibits Poland, Hungary and Greece (more than 50 %).
2. Japan is a case of interest among developed countries as it exhibits a low level of state support allocated to R&D (20 %), compensated by substantially higher expenditures of the private sectors. The USA show a high federal support allocated to R&D (obviously owing to high financing of defence- and space-related R&D); but it is gradually decreasing.
3. In most EU countries the proportion of state financing ranges between 30 and 40 % (average of EU countries amounts to 36 %). The proportion of the Czech Republic is slightly higher (43 %) than the EU average.
4. Prospective increase of R&D expenditures allotted from the state budget should be accompanied by the increase of expenditures devoted from other sources, primarily from private sector.
5. Barcelona Declaration of member states of 2000 recommended to increase total expenditures on R&D to 3 % of GDP.

A 4. Expenditures on civil R&D – 1999 data

(total expenditures on civil research and development in per cent of GDP)



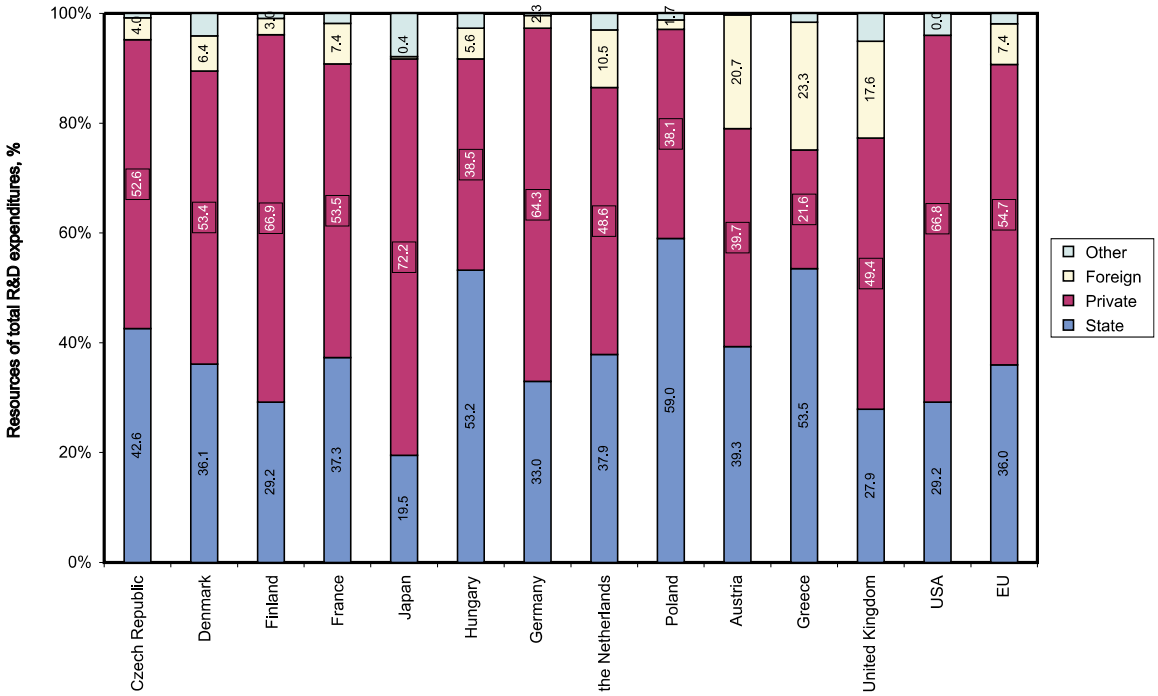
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Data shown for Greece are from 1993. The source does not list data referring separately to defence and civil R&D for Poland and Hungary. The data shown for Japan are from 1994 and for the Netherlands from 1998.

Commentary

1. The difference between total expenditures and civil expenditures represents expenditures allocated to defence-related research and development.
2. A substantial part of total expenditures on R&D is devoted to defence research and development only by the nuclear superpowers (USA, Great Britain and France from the countries in question), where they amount to more than 15 % of total expenditures on R&D. This ensues not only from direct costs incurred in connection with development of new weapons but also from the support extended to some areas of basic and applied research related to defence research and development.
3. The remaining countries devote less than 5 % of total R&D expenditures to defence research and development. A number of countries have no or essentially no defence industry and, accordingly, their R&D bears almost exclusively civil character (Austria, Denmark, Greece, and Finland).

A 5. Resources of total R&D financing – 1999 data

(resources of total R&D expenditures in per cent)



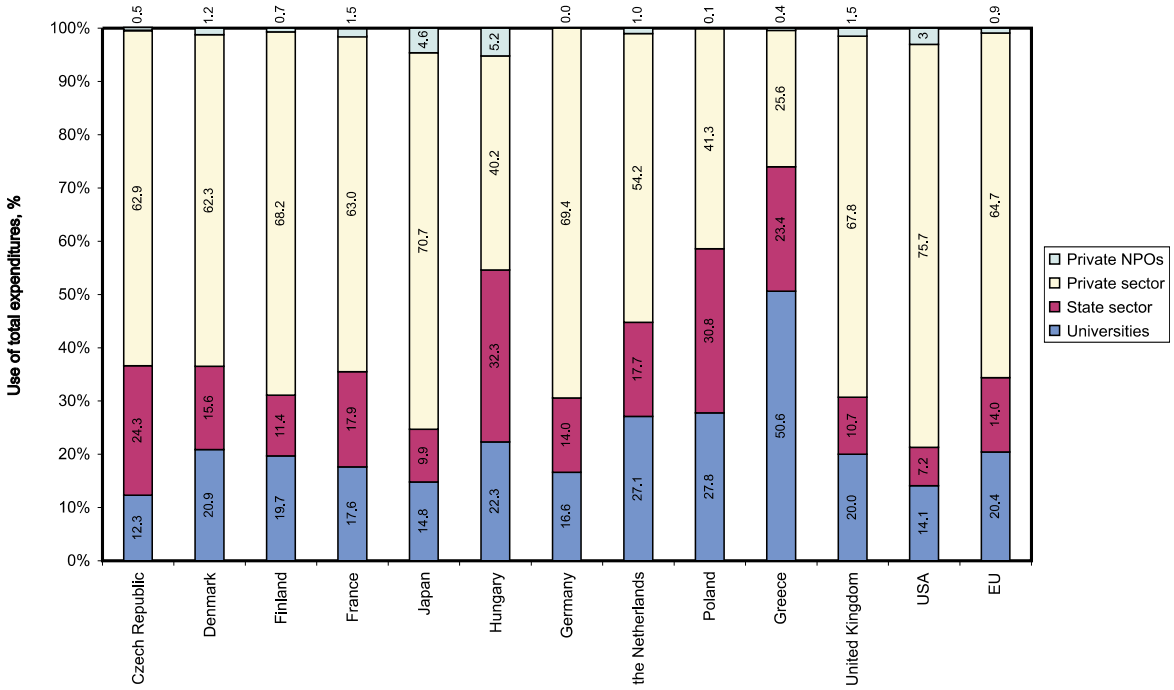
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Data for 1999 are incomplete. Latest available data for Denmark and Greece are from 1997 and for the Netherlands, the EU countries, and France from 1998.

Commentary

1. In OECD countries the state budget contributes almost 40 % to total R&D expenditures; the smallest value is reported from Japan characterised by a large proportion of industrial giants and low level of GDP redistribution via the state budget. The Czech Republic also shows a relatively low proportion of the state contribution in total R&D expenditures, comparable with the EU average.
2. There is a high proportion of foreign resources in Great Britain, the Netherlands and Denmark (and in Ireland, not shown in the Figure) owing to investments by the US and Japanese firms. The high foreign contributions in Greece (and in Portugal – not shown) stem from the EU budget. The two countries have been censured for excessively exploiting EU budget and asked to contribute more to R&D themselves. Also the low level of R&D expenditures (predominantly business ones) in countries of Central and Eastern Europe is the subject of criticism.
3. The proportion of other sources (donations, private funds etc.) is very low with the exception of Japan.

A 6. Use of R&D funds – 1999 data

(classification of total R&D expenditures by sector, in per cent)



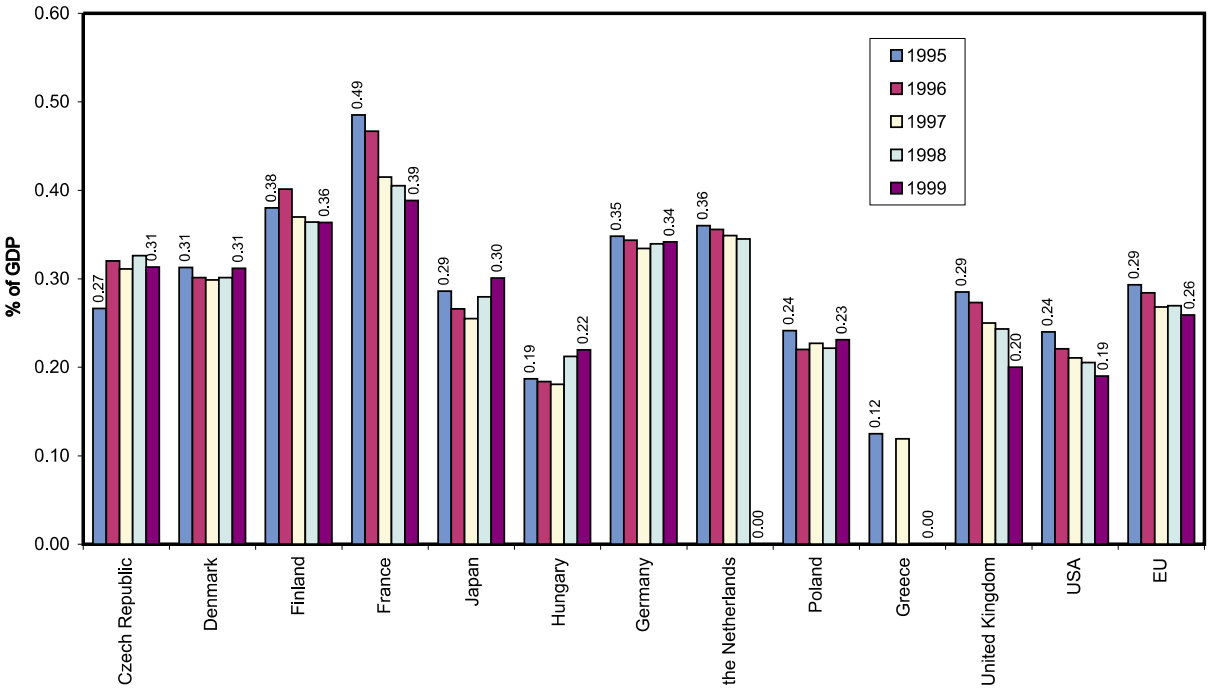
Source: OECD – Main Science and Technology Indicators 2001/1
Note: In OECD the state sector comprises also organisations financed primarily from the state budget, including public-sector organisations (except universities). NPOs (non-profit organisations) are private, not-for-profit legal entities. Last data available cover 1997 for Greece and 1998 for the Netherlands.

Commentary

1. In the most developed economies more than 60 % of the total R&D expenditures are targeted to private-sector research and development. This still applies also to the Czech Republic although a steady decline has been apparent. The very low proportion of privately financed R&D in Greece is due to the structure of the industry where sectors characterised by low demand on R&D prevail.
2. In the Czech Republic the proportion of total R&D expenditures devoted to universities is the lowest among all countries examined, but has started to grow rapidly in recent years. There is a distinct difference between the G7 and small countries. In the G7 countries the universities use less than 20 % owing to the effect of enterprises represented by industrial giants, often globally oriented. In smaller countries universities use some 25 % of the total expenditures. Greece shows a higher proportion still as the private sector is less significant there and R&D is concentrated at the universities.
3. In the Czech Republic the state sector (comprising resort research institutions and the Academy of Sciences) has previously utilised a substantial part of funds devoted to R&D, but a continuing decline is already apparent and the Czech Republic now approaches the standard of developed EU countries.
4. State budget expenditures in the Czech Republic are distributed via budgetary chapters of central state administration authorities as well as via the chapters of the Academy of Sciences and the Czech Grant Agency.

A 7. Trend of total R&D expenditures in the state sector

(trend of total R&D expenditures used in the state sector; per cent of GDP)



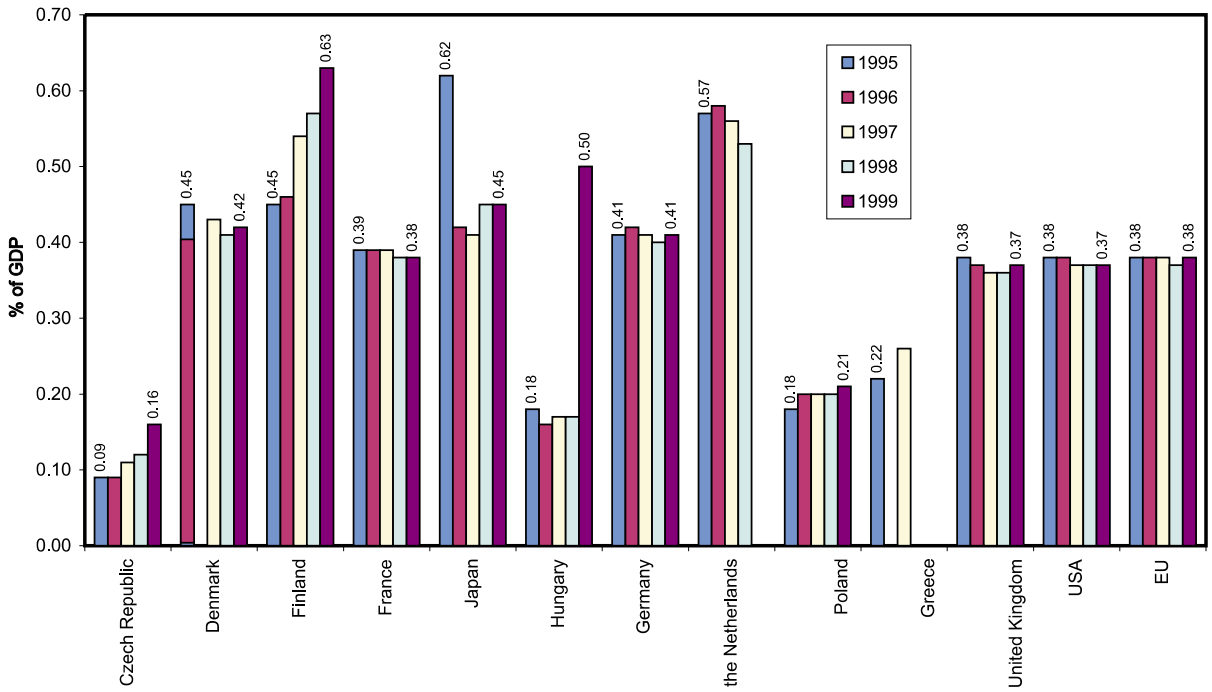
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Incomplete columns for some countries indicate lack of data.

Commentary

1. In the EU the trend of R&D expenditures in the state sector (relative to GDP) exhibits a moderate decline (see EU average). Owing to the fact, that the GDP grows in analysed countries, in actual terms the state financing stagnates.
2. In the Czech Republic funds devoted to R&D in the state sector slumped starting in 1991 (0.62 % of GDP) to almost one half in 1995. The reason for this reduction was privatisation and dissolution of a number of resort research institutions (the Ministry of Industry and Trade now has no research institute of its own), in part also by the restriction of funds allocated to the Academy that took place in 1993.
3. Among developed countries the state sector assumes an important position in France and Finland (in both countries with a declining trend). State sector funds in the USA are somewhat lower than in most EU countries.

A 8. Trend in total expenditures allocated to university R&D

(trend in total expenditures devoted to university R&D in per cent of GDP)



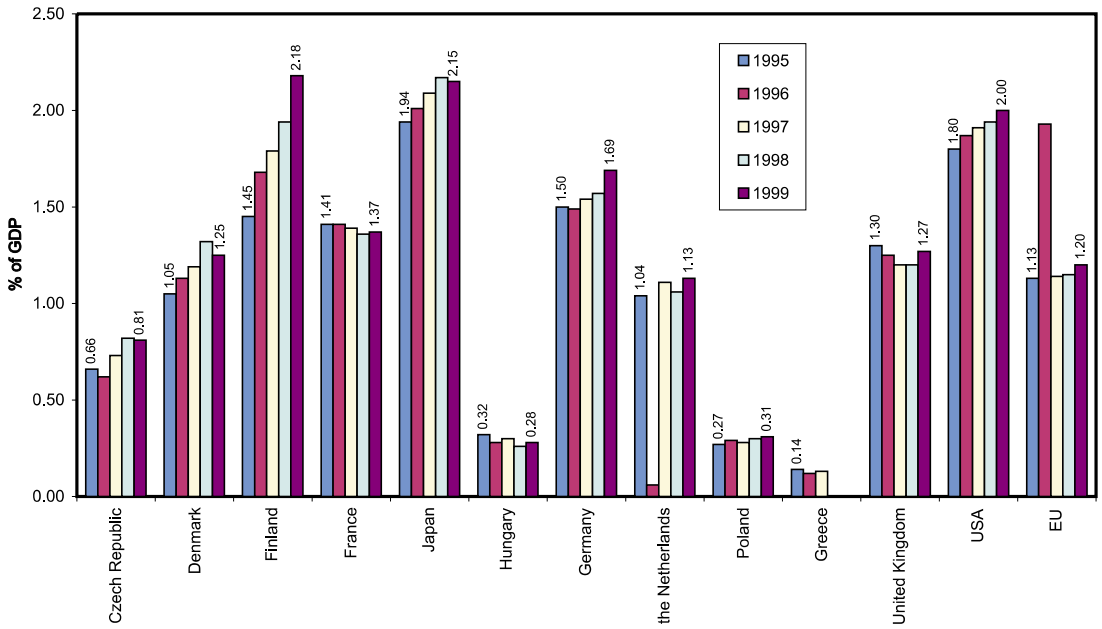
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Incomplete columns for some countries indicate lack of data.

Commentary

1. R&D expenditures of universities are by far the lowest in the Czech Republic over the examined period not only in comparison with traditional OECD countries but also lower than Hungary and Poland. The rate of growth of this indicator however demonstrates the increasing importance of university R&D.
2. One of the reasons underlying the difference between the Czech Republic and foreign countries is the fact that in the Czech Republic university R&D is financed almost exclusively from the state budget whereas the private sector plays a more important role abroad.
3. University R&D expenditures have stabilised in most countries. There is no explanation for the eye-catching recent development in Japan.
4. The trend in Austria characterised by traditionally strong university research and development is not apparent from the above Figure owing to the lack of data.

A 9. Trend in total R&D expenditures in the private sector

(trend in total R&D expenditures in the private sector, in per cent of GDP)



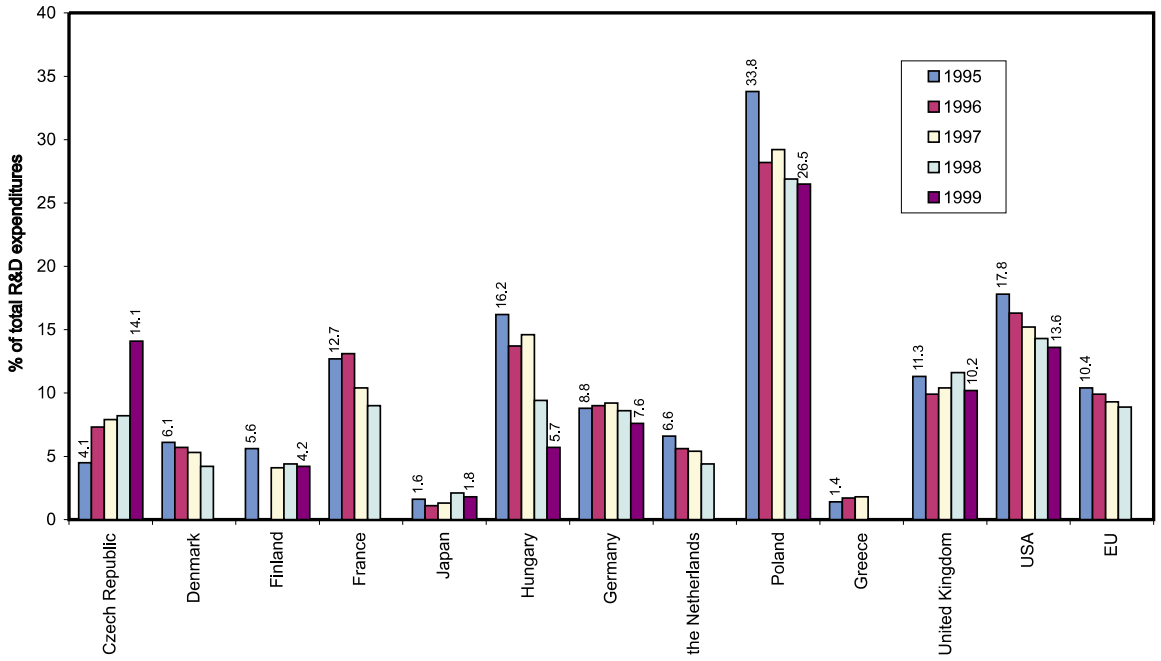
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Incomplete columns for some countries indicate lack of data.

Commentary

1. The decrease of total R&D expenditures in the private sector (often incorrectly called "business" sector) expressed in per cent of GDP in large European countries (France, Great Britain) was brought about, inter alia, by reduced demand for the defence industry products after the end of the cold war. In the USA this trend has been stopped and a growth is already apparent.
2. Expenditures devoted to private R&D in smaller European countries, in particular in the Netherlands, Denmark and Finland, increased between 1995 and 1999 as participation of these countries in defence-related R&D was insignificant. To a certain extent it holds true also of Germany and Japan.
3. Despite a slight increase of R&D expenditures in private sector between 1996 and 1998 the expenditures in the Czech Republic are still behind the EU average. The situation has not substantially improved in recent years. As a result the Czech Republic lags behind the EU and other developed countries with regard to expenditures on private R&D. This adverse trend is confirmed by the results of regular surveys conducted by the Confederation of Industry and Transport of the Czech Republic which confirm that large and medium-sized enterprises in the Czech Republic spend 1 to 2% of their annual revenues on research and development. In the EU countries, private firms invest 4 to 10% of their annual revenues in research and development depending on the respective sector. Moreover, private enterprises in the Czech Republic prefer short-term programmes and tasks expected to bring immediate return of capital. More essential and long-term research is not established and financed. This fact is caused by a number of reasons including practically non-existent indirect support extended to private research and development.
4. In the Czech Republic a slight increase of total R&D expenditures in private sector is apparent in the examined period. Even though the number is twice as large as in Poland and Hungary, however it is half-size in comparison with the EU countries average.

A 10. Trend of state participation in financing private R&D

(state support extended to private R&D in per cent of overall R&D expenditures)



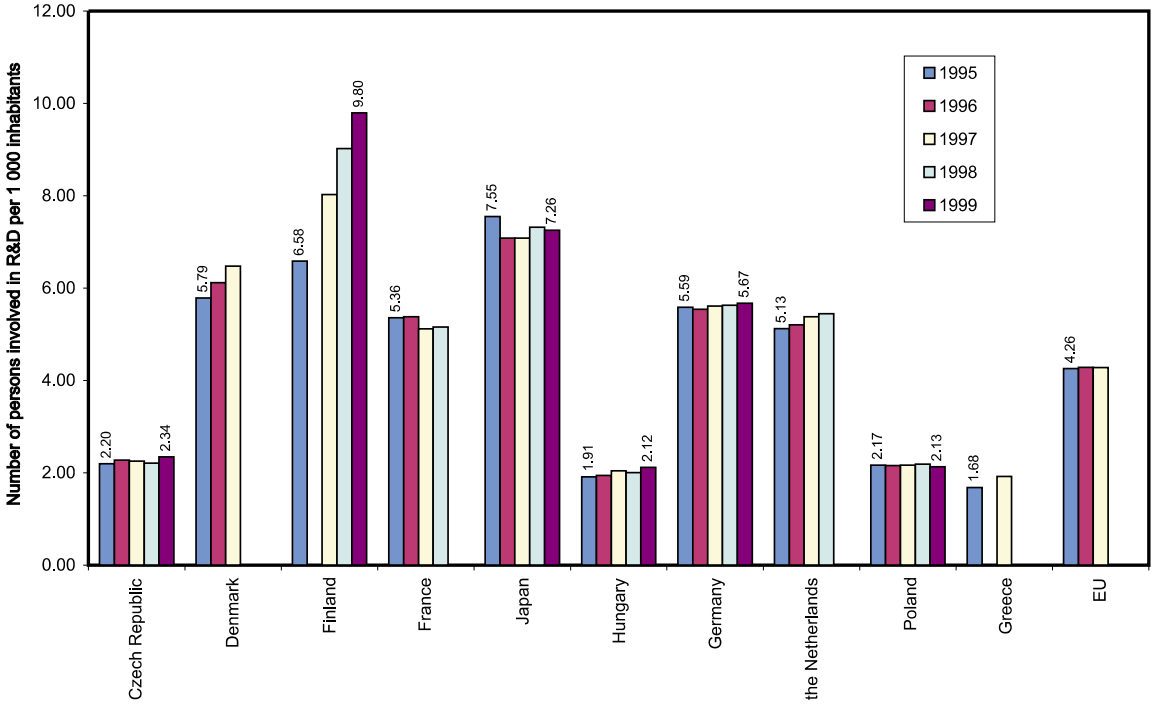
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Incomplete columns for some countries indicate lack of data.

Commentary

1. The first years of economic transformation in the Czech Republic (also in the Czech and Slovak Federative Republic from 1990 to 1992) were characterised by a rapidly declining participation of the state funds in private R&D financing. Starting in 1995, the support extended by the state has continued to rise (significantly since 1999).
2. Big countries, especially USA, France, Great Britain (but not Japan) co-finance private R&D to substantial extent through defence contracts. Their decline after the end of the cold war is the reason for the distinctly decreasing trend of state co-financing of private R&D.
3. A similar decline was not apparent in Germany where the trend of R&D expenditures was not influenced by any slump in the defence industry.
4. Exceptionally high participation of the state in financing private R&D in Poland and Hungary is obviously due to the involvement of the State in restructuring the industry, adequate innovation policies, and participation in efforts aimed at increasing technological level of industry. However, in recent years the state subsidies have shown a distinctly decreasing trend.

A 11. Trend of workforce involved in R&D

(number of persons employed in R&D adjusted for full-time employment (Full Time Equivalent, FTE) per one thousand inhabitants)



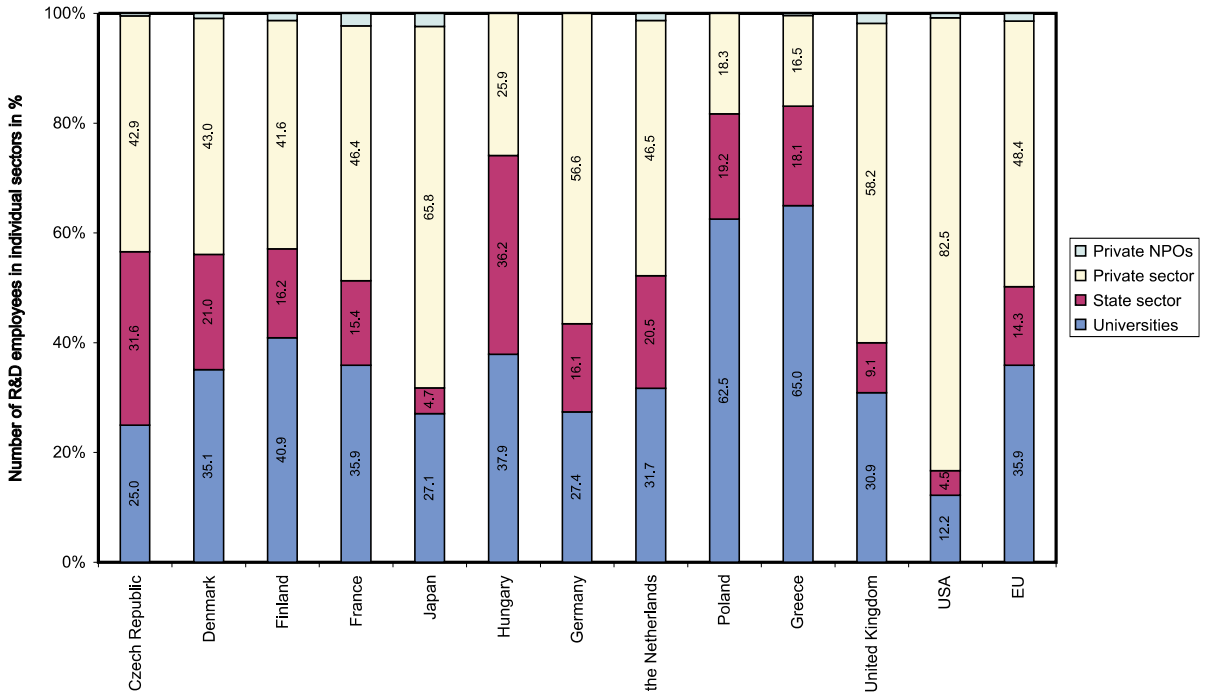
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Numbers are adjusted for full-time employment (FTE) according to OECD methodology. Incomplete columns for some countries indicate lack of data.

Commentary

1. There is a positive correlation between the number of persons employed in R&D and the total R&D expenditures; it is especially significant between the headcount and expenditures stemming from private resources.
2. Part-time employment in the R&D sector is relatively common everywhere, especially at the universities. Without the FTE adjustment the resulting workforce would be about twice as high.
3. In the Czech Republic the previous decrease in the absolute number of persons involved in R&D has been arrested. Without the FTE adjustment (so called labor force referred to in the sources) the number of persons involved in R&D per 10 000 employees would be 44 in 1995 and 45 in 1996.

A 12. Classification of R&D workforce by sector – 1999 data

(headcount of R&D FTE-adjusted employees in individual sectors in per cent)



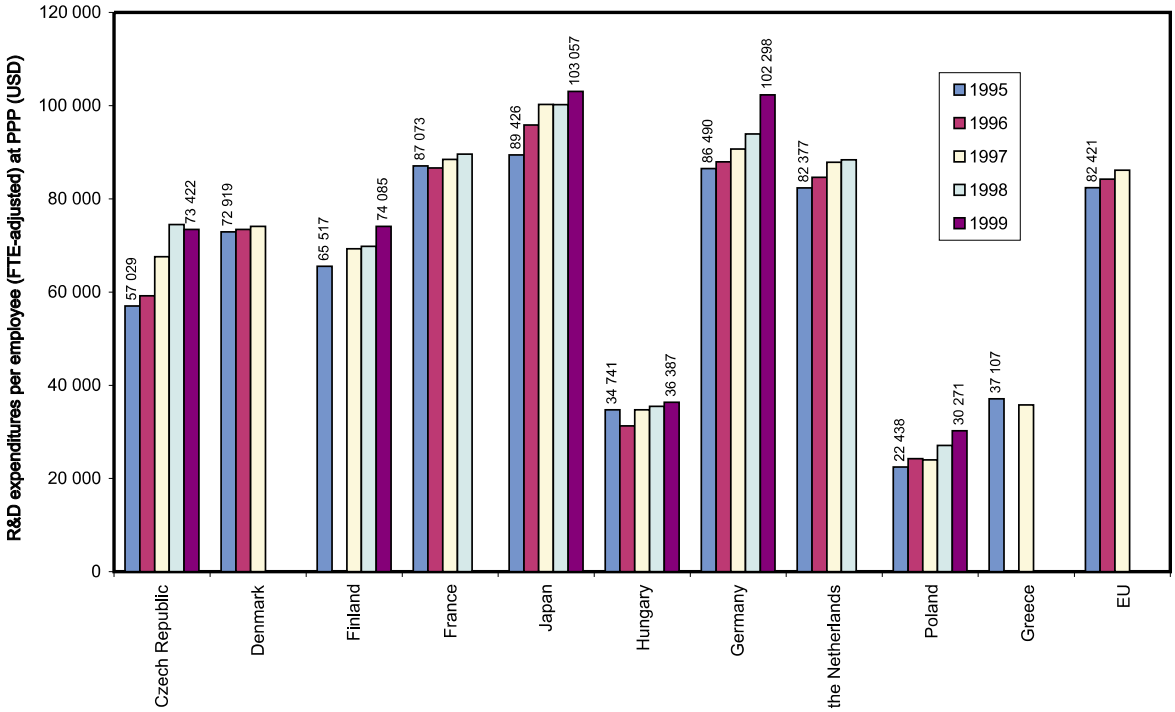
Source: OECD – Main Science and Technology Indicators 2001/1
Note: "Private NPOs" represent the private non-profit sector. 1997 data refer to Denmark, Greece, USA and EU. Last available data are for France and United Kingdom.

Commentary

1. The number of persons employed in R&D and the funds devoted to R&D in individual sectors are approximately in line. The number of university R&D employees is, with the exception of Austria, somewhat higher. It is an accepted fact that the R&D is the cheapest at universities and most expensive in the private sector.
2. The average value for the EU indicates that more than one half of persons employed in R&D work in the private sector; the corresponding figure is only one half as high in the Czech Republic. Despite the moderate decline in the total number of R&D employees in the developed countries the trend almost did not affect the private sector.
3. In the Czech Republic the state sector involves resort research institutes and the Czech Academy of Sciences. Accordingly, the number of persons employed in state R&D is higher here than the EU average (16.8 % in the EU and 33.2 % in the Czech Republic in 1996).

A 13. Total R&D expenditures per employee in R&D

(total R&D expenditures in USD per employee – FTE-adjusted – at purchasing power parity)



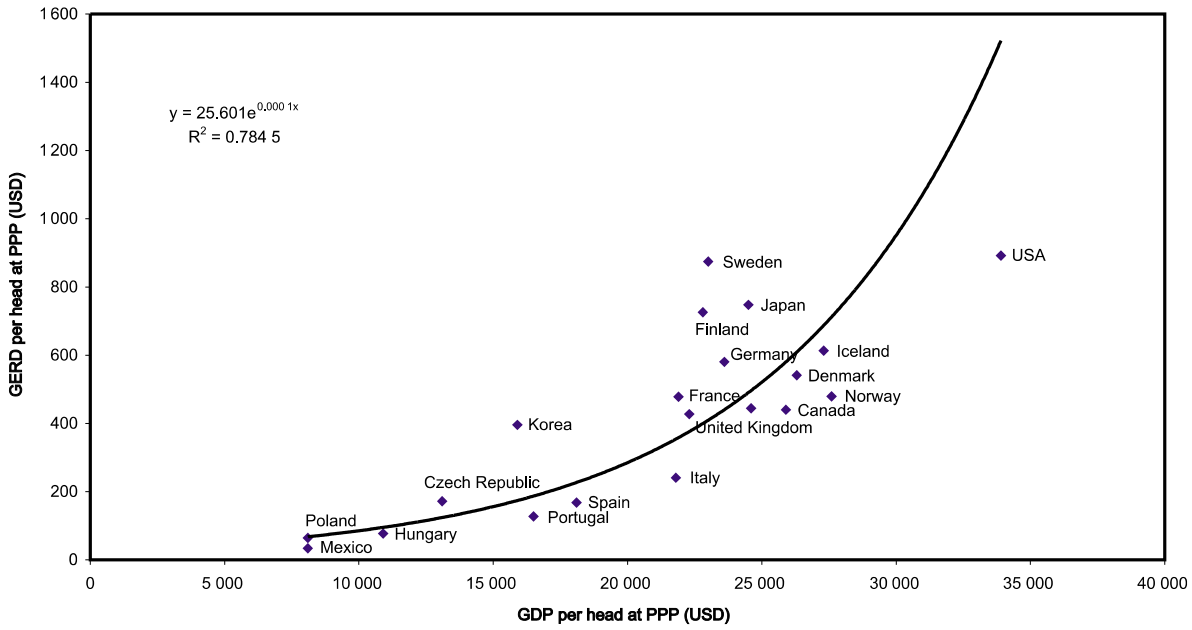
Source: OECD – Main Science and Technology Indicators 2001/1
Note: Incomplete columns for some countries indicate lack of data.

Commentary

1. R&D expenditures per employee are strongly affected by purchasing power parity of individual currencies.
2. The adjusted R&D expenditures per employee correlate neither with the GDP nor with the R&D expenditures, nor even with the structure of individual R&D sectors.
3. The level of wages in individual countries is very important, and so is – to a certain extent – the tradition in remunerating R&D employees relative to other professions.
4. One may nevertheless note that in developed countries the R&D expenditures per employee are essentially the same. They are significantly lower in Hungary and Poland, while the Czech Republic gradually approaches the EU countries.

A 14. Total R&D expenditures and GDP – 1999 data

(dependence of total R&D expenditures on GDP – both indicators at purchasing power parity per inhabitant)



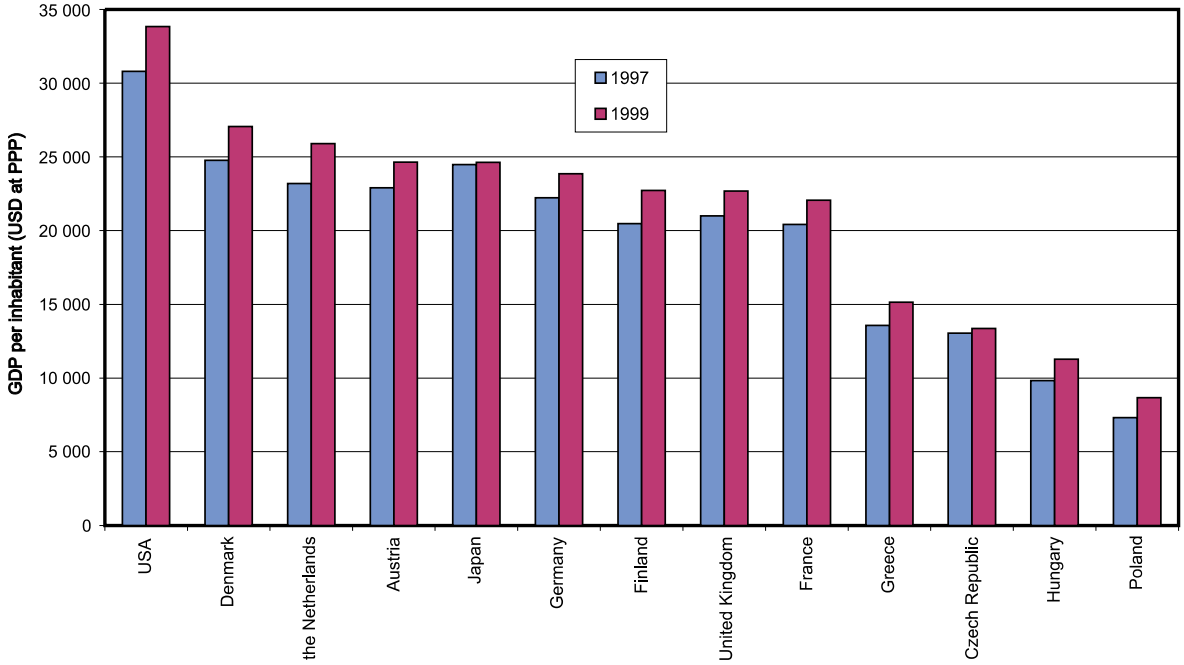
Source: OECD in Figures (statistics on the member states, 2000 edition)
Note: GERD – total R&D expenditures.

Commentary

1. Rich countries devote more funds to R&D not only in absolute terms (proportionally to the higher GDP per head) but also relatively (larger proportion of GDP per head), resulting in further GDP growth.
2. It is generally true that the economic development is preceded by technical progress ensuing from innovations. Progress based on utilising results of research represents almost exclusive source of innovations. Accordingly, support extended to R&D is expected to lead to economic growth and the preceding figure may be interpreted accordingly. Attempts to determine in an exact manner the causality between R&D expenditures and the gross domestic product however meet with serious difficulties due to the extraordinary complexity of relationships between research and development and other activities like transfer of results of R&D to the private sector, the unavoidable capital construction, marketing, commercial and service activities etc. The above figure can be therefore interpreted in the opposite manner – rich states may afford to invest more in R&D and poor countries will benefit from the general progress without financing it. Thus, economics does not provide unequivocal interpretation of the figure.
3. The situation in microeconomy is simpler. Firms that invest more extensively in R&D enjoy increasing growth of both revenues and earnings (nothing automatic in that, though – many prerequisites are involved). To simplify somewhat: should higher R&D expenditures initiate a growth of GDP in the Czech Republic, they must be accompanied (and perhaps preceded) with fundamental restructuring of enterprises.

OECD STATISTICS – COMPARISON OF VARIOUS COUNTRIES

A 15. Evolution of gross domestic product per inhabitants



Source: OECD – Main Science and Technology Indicators 2001/1

Quantitative OECD data about R&D are presented in per cent of gross domestic product (GDP). Differences in GDP per head between individual countries however translate into substantial differences in actual R&D expenditures. For illustration, we therefore present a figure depicting the trend of gross national product (in fixed 1995 prices). Issues concerning broader inter-relation between macroeconomic indicators and GDP are resolved in Chapter G, Economic performance and R&D. Data for the attached Figure were taken from OECD statistics (in contrast to graph G 1 which is based on EU statistics).

To compare the data for individual countries (except the USA) GDP expressed in national currencies was translated to USD using purchasing power parity.

Purchasing power parity (PPP) is a standard economic category; specific values for a given currency are calculated by means of a consensual method generally accepted throughout OECD (by analysing a market basket in each country). Without PPP any comparison of data for different countries would be meaningless.

In stable, low-inflation economies changes in purchasing power parity of national currencies are very small, in contrast to transforming economies experiencing higher rates of inflation.

Official OECD documents state the following figures for PPP for the Czech crown.

Purchasing power parity of CZK

(Czech Crowns, CZK, for 1 USD)

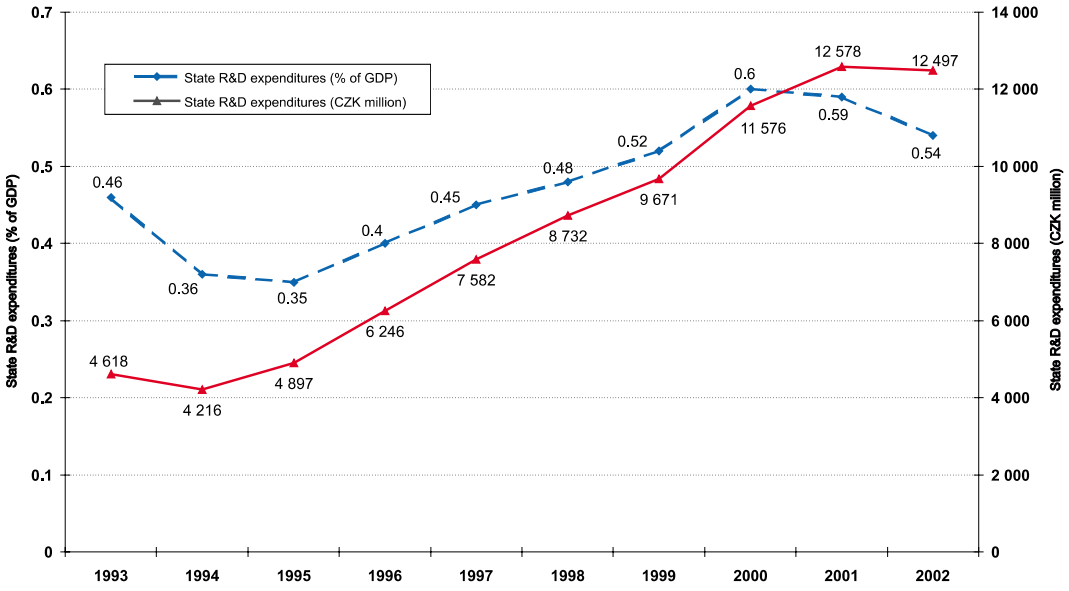
	1995	1996	1997	1998	1999	2000
PPP	10.81	11.69	12.41	13.50	13.36	13.33

Source: OECD – Main Science and Technology Indicators 2001/1

Numbers of persons employed in R&D sector have been reduced to Full Time Equivalent (FTE) according to OECD methodology since part-time employment is commonplace in the R&D sector, in particular in university R&D sector where a substantial part of time is devoted to teaching activities (the problem often is to differentiate between the two).

To compare the Czech Republic with the developed countries thirteen OECD countries were selected in Chapter A: the first five (USA to Great Britain) belong to a group of most developed countries known as G 7; the next four (Denmark to Finland) are approximately comparable to the Czech Republic as to size, and Greece is comparable to the Czech Republic also as to economic level although differences in the structure of the two economies are substantial. Portugal, another comparable country, is not included as data are mostly missing and, if available, are very similar to those of Greece. Hungary and Poland, two countries also aspiring at accession to the EU, are included. Graphs contain also a weighted average for the EU member states. Graphs A 11 to A 13 referring to R&D workforce do not depict the USA as OECD statistics fail to contain the relevant data.

B 1. Trend of state R&D expenditures



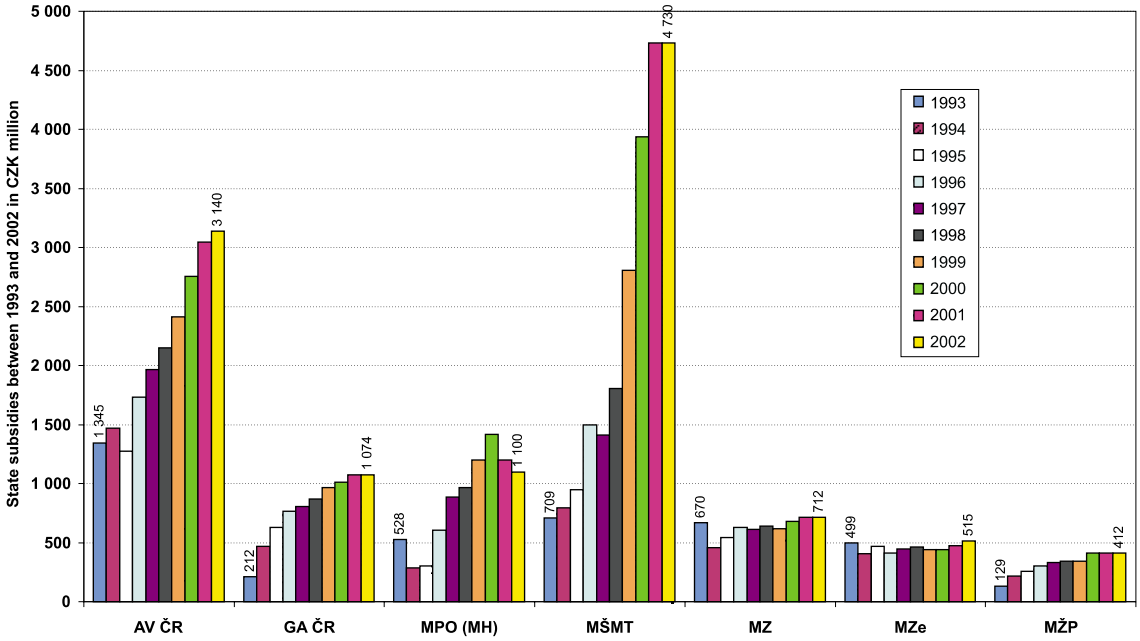
Source: State budget of the Czech Republic, 1993–2002
Note: The figures referring to % GDP and R&D expenditures are based on data published by the Ministry of Finance. The latter differ from data promulgated by the Czech Bureau of Statistics (CBS), employed in Part A.

Commentary

1. The R&D expenditures expressed in standard EU or OECD countries indicator (% of GDP) were rising only till 2000, when were at the highest level throughout the existence of the Czech Republic – 0.6 % GDP.
2. Slight decrease in 2001 and significant slump in 2002 were the result of the fact that the Government and individual resorts started, as their budgetary priorities, to give preference to short-term measures with immediate effects to longer-term ones, one of which is research and development. The obligations both to the EU and the society expressed in the resolutions of the Government,[1] were not met.
3. The mentioned development of R&D support from the state budget was reflected in the current prices of that year. R&D expenditures substantially increased between 1994 and 2000, only slightly in 2001 and declined in 2002. In fixed prices – cleared of inflation – the trend of R&D expenditures is less favourable and in fact corresponds to the expenditures expressed in % of GDP.
4. The effect of rapidly curtailed state expenditures on research and development in 1990 through 1992 was still apparent between 1993 and 1995 (expenditures in % of GDP) or, as the case may be, between 1993 and 1994 (expenditures in current prices).
5. Favourable change took place in 1996 and 1997 after the adoption by the Government of the first Principles Governing Research and Development (in 1994, as a part of the preparations for the 1995 budget, and therefore not yet reflected in 1995 R&D budget). The slump of expenditures expressed in % of GDP in the preceding period which reduced the R&D expenditures in 1995 to 0.336 % of GDP, was arrested.
6. Economic woes, apparent after 1997, together with the ensuing streamlined government expenditures resulted in the reduction of the rate of growth of the State R&D expenditures.

[1]) The Czech Government in its Resolution No. 249 of March 22, 1999 undertook to raise state expenditures on R&D to 0.6 % GDP in 2000, 0.65 % of GDP in 2001 and to 0.7 % of GDP in 2002.

B 2. Trend of state subsidies extended to research and development in some selected resorts



Source: State budget of the Czech Republic, 1993–2002
Note: AV ČR = Academy of Sciences of the Czech Republic, GA ČR = Grant Agency of the Czech Republic, MPO = Ministry of Industry and Trade, MŠMT = Ministry of Education, Youth and Sport, MZ = Ministry of Health, MZe = Ministry of Agriculture, MŽP = Ministry of Environment, (MH = now defunct Ministry of Economy, its competences with regard to R&D passed to the Ministry of Industry and Trade in 1996).

Commentary

1. Total support of research and development provided from the state funds is in fact equal to the state budget support in the period in question; support extended from other public sources is negligible. Data for individual years are in current prices.
2. Academy of Sciences of the Czech Republic and the Grant Agency of the Czech Republic: the amount of state support in current prices in the given year grew (with the exception of the Academy of Sciences where temporary decrease in 1995 was reported). These budgetary chapters support only research and also provide for all related expenditures
3. Ministry of Industry and Trade: the support was insufficient until 1995. Its growth between 1996 and 2000 corresponded to the importance of that ministry for the sphere of research and development. In 2001 total expenditures of the budgetary chapter of the Ministry of Industry and Trade increased in comparison with the previous year, but in 2002 they were substantially reduced. In 2001 the Ministry of Industry and Trade gave preference to other short-termed priorities, in 2002 with a view to the reduction of funds of the Ministry of Industry and Trade budgetary chapter also the R&D support was reduced.
4. Ministry of Education, Youth and Sport: the growth of support by 2001 was due to an enormous increase of international activities of the Czech Republic and, in addition, legislative changes in the status and financing of university education, corresponding to its meaning in the EU or OECD countries. In 2002 current prices experienced stagnation which in fixed prices resulted in the decline of support of research at universities. The decline of a current level of support was

multiplied by the fact that the fees paid for the participation in international activities increased substantially in 2002.

5. Ministry of Agriculture and the Ministry of Health: the support in current prices is more or less constant (which means decline in fixed prices). At present the proportion of university research on total state subsidies roughly corresponds to the support provided to analogous research in developed countries.
6. Ministry of Environment: following the growth between 1993 and 2001 also this resort experienced stagnation. In resorts not mentioned in this graph the situation is analogous.

B 3. Trend of institutional support provided to research in selected resorts

Source: State budget of the Czech Republic, 1993-2002
Note: AV ČR = Academy of Sciences of the Czech Republic, GA ČR = Grant Agency of the Czech Republic, MPO = Ministry of Industry and Trade, MŠMT = Ministry of Education, Youth and Sport, MZ = Ministry of Health, MZe = Ministry of Agriculture, MŽP = Ministry of Environment, (MH = now defunct Ministry of Economy, its competencies with regard to R&D passed to the Ministry of Industry and Trade in 1996).

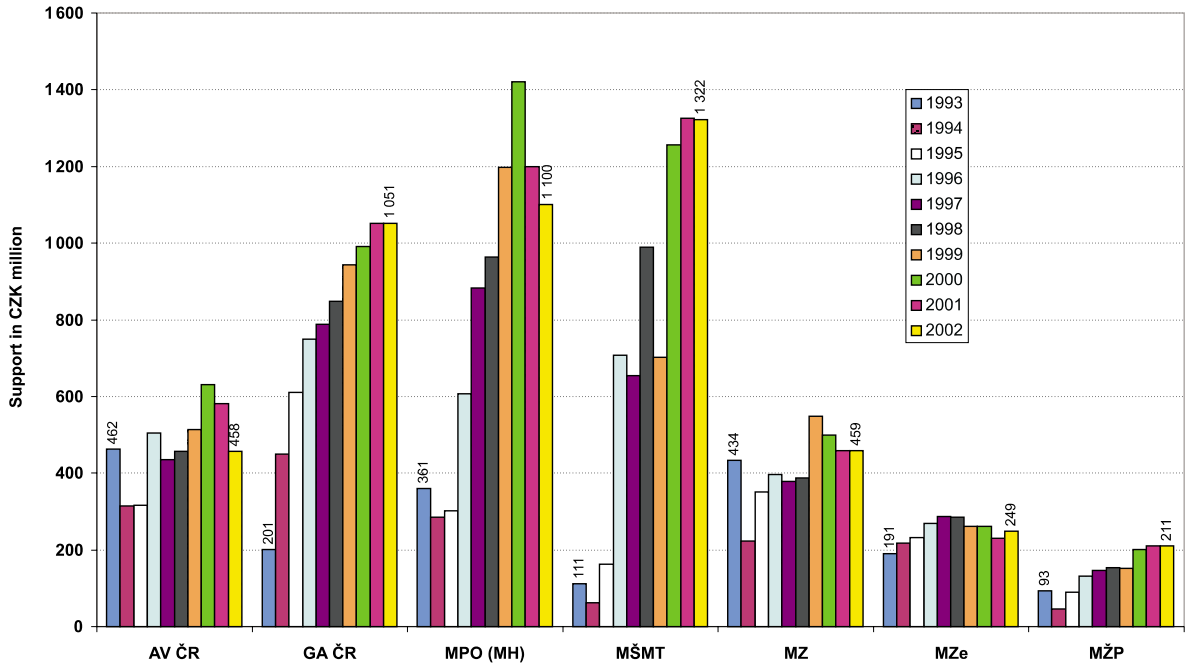
Commentary

1. The expenditures on research extended from institutional funds in the period in question between 1993 and 1998 acquired the form of a subsidy to contributory and budgetary organisations, since 1999 this support is provided to the research plans of particular organisations (with respect to the Ministry of Education, Youth and Sport this support is subdivided – see further). Data referring to individual years are in current prices.
2. Academy of Sciences of the Czech Republic: the institutional support in current prices in the period in question grew (except in 1995 when temporary decline was experienced). It is a budgetary

chapter of which only research is supported and the costs related to the activities of the Academy of Sciences are paid from the expenditures devoted to it.

3. Grant Agency of the Czech Republic: the expenditures on its activity which – following a slight increase in 1993 to 1997 related to the expansion of activities – have recently experienced stagnation.
4. Ministry of Industry and Trade: due to its competence (it is concentrated on industrial research and development) is the only resort examined which does not provide this kind of support. Expenditures in 1993 are the residuals of activity of the former Ministry of Economy. In 2001 the Ministry of Industry and Trade gave preference to other short-termed priorities, in 2002 due to the reduction of the Ministry of Industry and Trade budgetary chapter funds also the R&D support was reduced.
5. Ministry of Education, Youth and Sport (as the only resort): the institutional support consists of 3 parts – institutional support of organisations (particularly universities) as such pursuant to point 1, support of specific research at universities (research related to the education of students) and of the fees paid for the participation of the Czech Republic in the EU Framework Programmes. Abrupt growth of support in the period from 1998 to 2001 is particularly due to the growth of support of research plans of the universities, to a lesser extent to the growth of fees paid for the participation of the Czech Republic in the EU Framework Programmes.
6. Ministry of Health: the institutional support in current prices remains more or less constant (representing an actual decline in fixed prices). Temporary decline experienced in 1999 was due to the attempt of the former management of this ministry to substantially increase the proportion of targeted support.
7. Ministry of Agriculture: the institutional support in current prices following the initial decrease in 1993 to 1996 related to privatisation of research institutes has been slightly but steadily growing.
8. Ministry of Environment: after the initial growth in 1994 the trend has been stagnating. In resorts not mentioned in this graph the trend is analogous.

B 4. Trend in targeted support of research and development in selected resorts



Source: State budget of the Czech Republic, 1993–2002
Note: AV ČR = Academy of Sciences of the Czech Republic, GA ČR = Grant Agency of the Czech Republic, MPO = Ministry of Industry and Trade, MŠMT = Ministry of Education, Youth and Sport, MZ = Ministry of Health, MZe = Ministry of Agriculture, MŽP = Ministry of Environment, (MH = now defunct Ministry of Economy, its competencies with regard to R&D passed to the Ministry of Industry and Trade in 1996).

Commentary

1. Targeted support of research and development in the given period acquired the form of support of projects based on the results of public tenders. Data referred to individual years are in current prices.
2. Academy of Sciences of the Czech Republic: targeted support in current prices in the period from 1994 to 2000 increased (with one exception – in 1995 temporary decline was experienced). In 2001 to 2002 the targeted support has been reduced, as the institutional support has been preferred.
3. Grant Agency of the Czech Republic: throughout the whole period in question targeted support experienced a steady growth which was in the initial years related to the establishment and spread of activities of the Grant Agency of the Czech Republic. Recently, this kind of support has reached its maximum considering the dimension of the Czech Republic (further increase of support would result in the growth of accepted project proposals however it would be accompanied by the decline of their quality).
4. Ministry of Trade and Industry: the same commentary referring to the total support holds true. Until 1995 the support provided to this ministry was insufficient. Its growth in 1996 to 2000 corresponds to the importance of that ministry for research and development. In 2001 the Ministry of Industry and Trade gave preference to other short-termed priorities, in 2002 due to the reduction of the Ministry of Industry and Trade budget chapter funds also the R&D support was reduced.

5. Ministry of Education, Youth and Sport: the growth of support in 1996 to 2000 was given by the enormous increase of international activities of the Czech Republic and, in addition, ensues from legislative changes in the status and financing of university education corresponding to its importance in the EU or OECD countries. Temporary decline in 1997 and 1999 was related predominantly to the temporary decrease of support of programmes designated not only for universities but for all research organisations. In 2000 to 2002 the current prices has begun to stagnate which represents – in fixed prices – the decrease of support of research programmes both at the universities and in other research organisations.
6. Ministry of Health: the level of targeted support in current prices grew till 1999, than it experienced slight but steady decrease. The analogous development was experienced with regard to the Ministry of Agriculture (MZe) and other resorts not mentioned in this Figure. This development was particularly due to the reduction of R&D total support which resulted in the limitation of the amount of financial means distributed via public tenders.
7. Ministry of Environment: in the period in question a slight but steady increase may be observed. This resort prefers the stagnation of institutional support (in current prices), i.e. in fact its reduction (in fixed prices).

C. Analysis of R&D information system data (R&D IS)

R&D IS is defined by Act No. 130/2002 Coll. on state-subsidised R&D and on the amendments of certain related acts (act on R&D support). The act defines the R&D IS as a public administration information system[1] providing collection, processing, provision and use of state-subsidised R&D data. It is divided into four interrelated parts: central evidence of R&D projects (CEP), central evidence of research plans (CEI), register of information on results (RIR) and evidence of public tenders in R&D (EPT). Pursuant to the law the aim of the R&D IS is to provide information on state-subsidised R&D to professional and general public including the foreigners and providers with a view to:

a) inform public and participants on R&D public tenders and their results,

b) inform public on state-subsidised projects and research plans and their results,

c) inform other subjects stipulated by special legal regulations[32] or international treaties,

d) control targeted or institutional support,

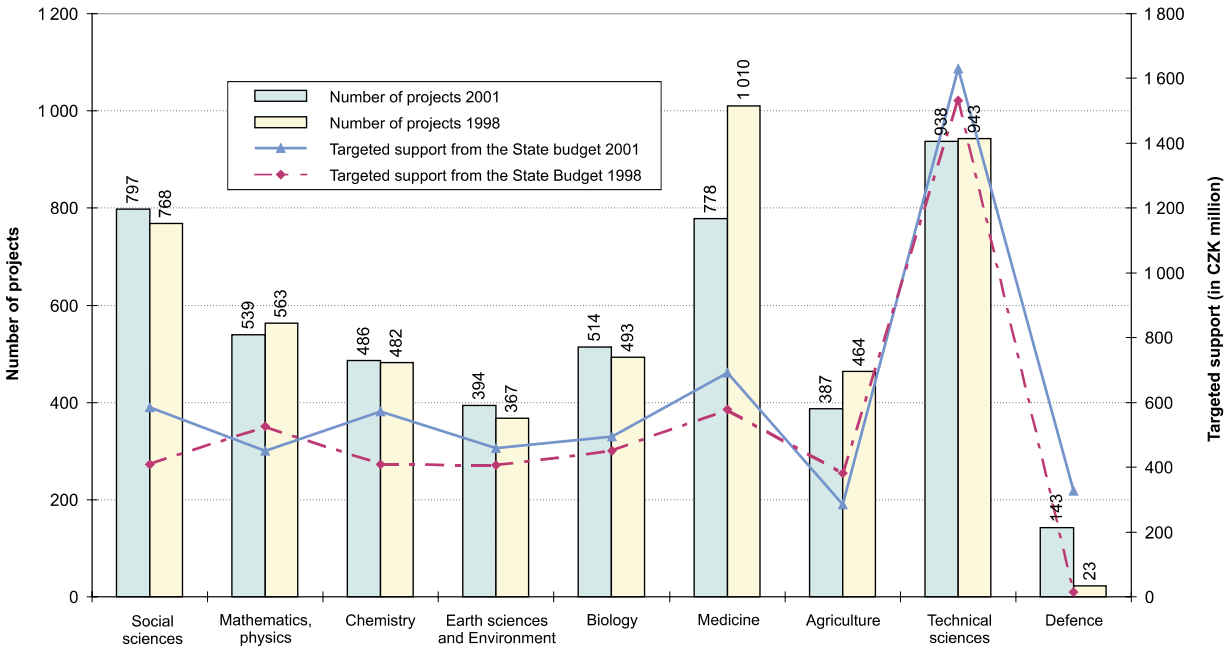
e) prepare state budget proposal and ensure other activities of providers or research and development bodies stipulated by special legal regulations[32] pursuant to this Act,

f) assess results and provision of information to the Government and public.

[1]) Act No. 365/2000 Coll. on public administration information system and on the amendment of certain other acts.
[32]) E.g. Act No. 123/1998 Coll. on the right to environmental information as amended by Act No. 132/2000 Coll.

C 1. ANALYSIS OF R&D PROJECTS (CEP)

C 1. 1. Classification of R&D projects by sector between 1998 and 2001

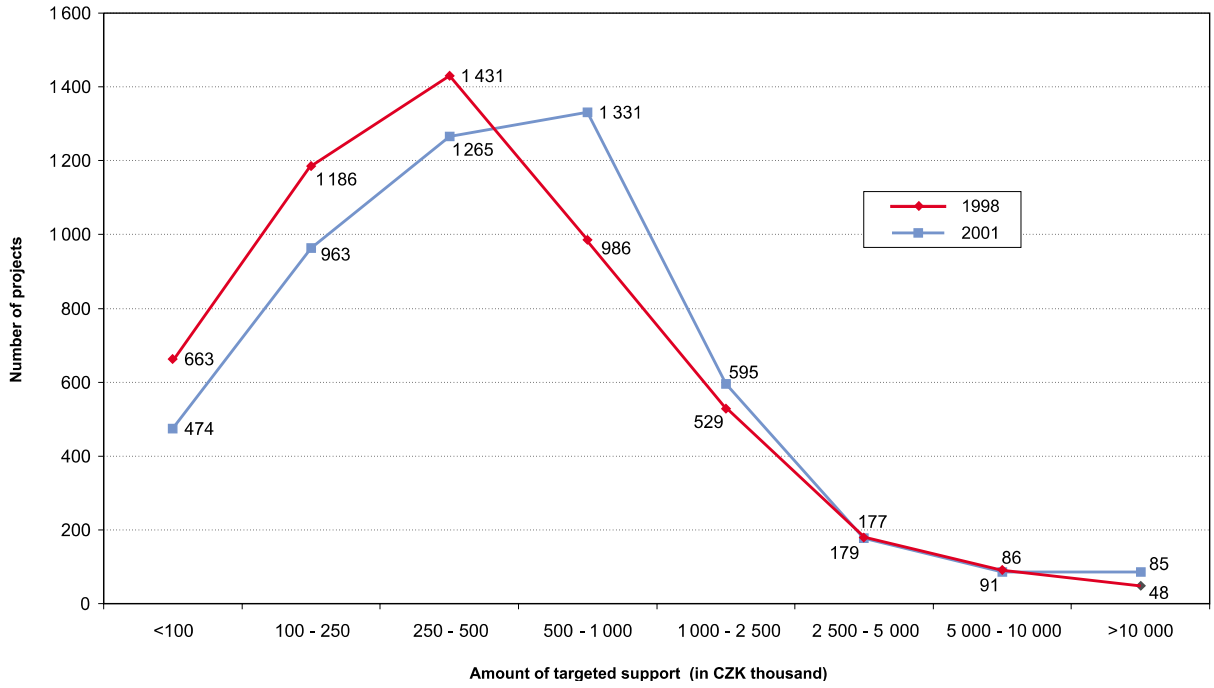


Source: Central Evidence of Research and Development Projects (CEP)

Commentary

1. Technical sciences which include the industrial research and development as a whole receive the largest amount of state subsidies devoted to research and development. It is partly owing to the fact that institutional financing of R&D is not implemented in the industrial research and development. Only in technical sciences is it apparent that the costs exceed the number of projects, in other words, projects in this sector are the most comprehensive and largest. Neither the number of projects nor the amount of support has changes substantially between 1998 and 2001.
2. Both the large number of project and the large costs – compared with the situation abroad – in social sciences is remarkable. While the number of projects in 1998 to 2001 slightly decreased, the costs substantially increased and in monetary terms they amount to more than 10 % of the total targeted support of R&D. In developed countries this proportion varies around 5 %. It may be in part attributed to development of some, previously neglected social disciplines after 1989.
3. Already large number of projects characterised by small average costs on one projects substantially increased in medicine in 1998 to 2001. The fact that the programmes in health care sector are very formal and are more eligible for grant projects has a negative effect.
4. Out of other resorts the growth of targeted support in defence related to a substantial reduction of number of projects is interesting. The concentration of funds on the solution of large, challenging projects is exhibited in this ssector.
5. Substantial changes in other sectors swere not observed between 1998 and 2001.

C 1. 2. Number of R&D projects pursuant to the amount of targeted support between 1998 and 2001

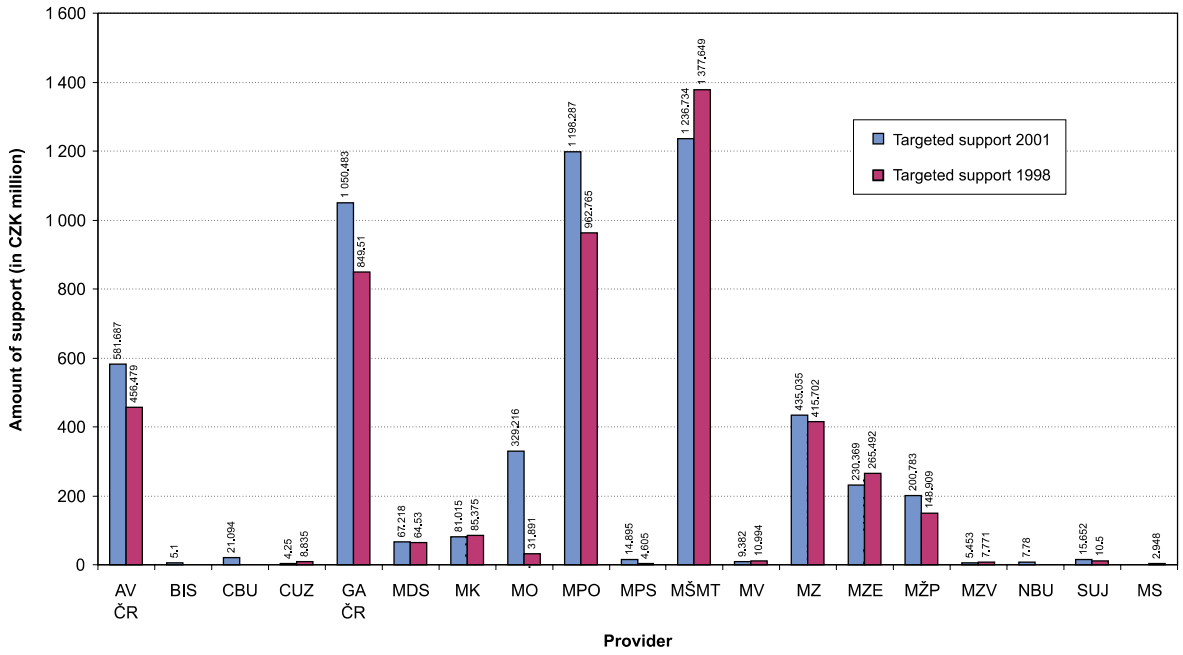


Source: Central Evidence of Research and Development Projects (CEP)

Commentary

1. It is apparent from the graph that smaller projects prevail over larger and more complex ones. However, in 1998 to 2001 a slight increase in favour of large projects was experienced but the curve by far does not depict standard distribution. Projects having the annual support of CZK 250–300 thousand prevailed in 1998, now slightly prevail projects having the annual support of CZK 500–1 000 thousand. The situation has not changed substantially since 1995 and neither the number of projects of over CZK 1 million has increased.
2. Only the slight decrease of a large number of projects having the support up to CZK 100 thousand where the costs on their assessment, control etc. do not differ from the amount of the support, is alarming.

C 1. 3. Targeted support of R&D projects pursuant to the providers between 1998 and 2001

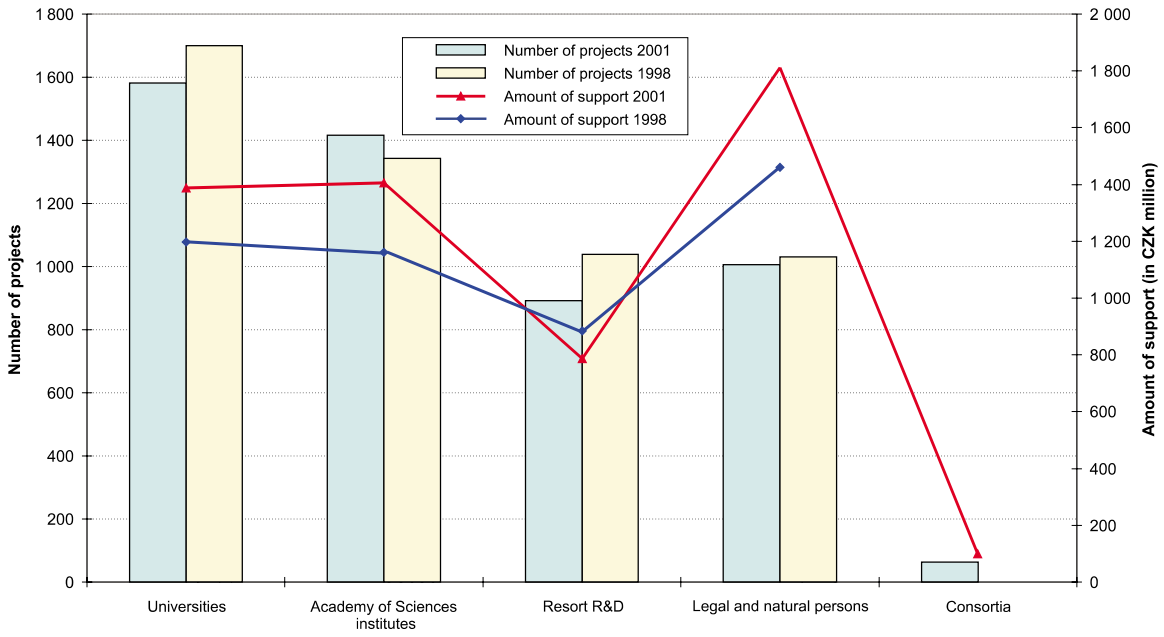


Source: Central Evidence of Research and Development Projects (CEP)
Note: AV ČR = Academy of Sciences of the Czech Republic, BIS = Security Intelligence Service, CBU = Czech Mining Office, CUZ = Czech Surveying and Cartographic Institute, GA ČR = Grant Agency of the Czech Republic, MDS = Ministry of Transport and Communications, MK = Ministry of Culture, MO = Ministry of Defence, MPO = Ministry of Industry and Trade, MPS = Ministry of Labour and Welfare, MŠMT = Ministry of Education, Youth and Sport, MV = Ministry of Interior, MZ = Ministry of Health, MZe = Ministry of Agriculture, MŽP = Ministry of Environment, MZV = Ministry of Foreign Affairs, NBU = National Security Authority, SUJ = State Nuclear Safety Office, MS = Ministry of Justice.

Commentary

1. This graph is analogous to that in part B "Trend of targeted R&D support in some selected resorts". R&D support provided from targeted funds was implemented as a support of projects based on results of public tenders in the mentioned period.
2. Academy of Sciences of the Czech Republic, Grant Agency of the Czech Republic, Ministry of Defence and Ministry of Industry and Trade: targeted support of projects substantially increased between 1998 and 2001.
3. Other resorts except the Ministry of Education, Youth and Sport: the amount of targeted support of projects did not substantially change between 1998 and 2001.
4. Ministry of Education, Youth and Sport: in the only resort the targeted support of projects between 1998 and 2001 declined particularly due to methodological changes (part of the activities started to be supported via an institutional form).

C 1. 4. Number of R&D projects and the amount of their targeted support pursuant to categories of recipients between 1998 and 2001

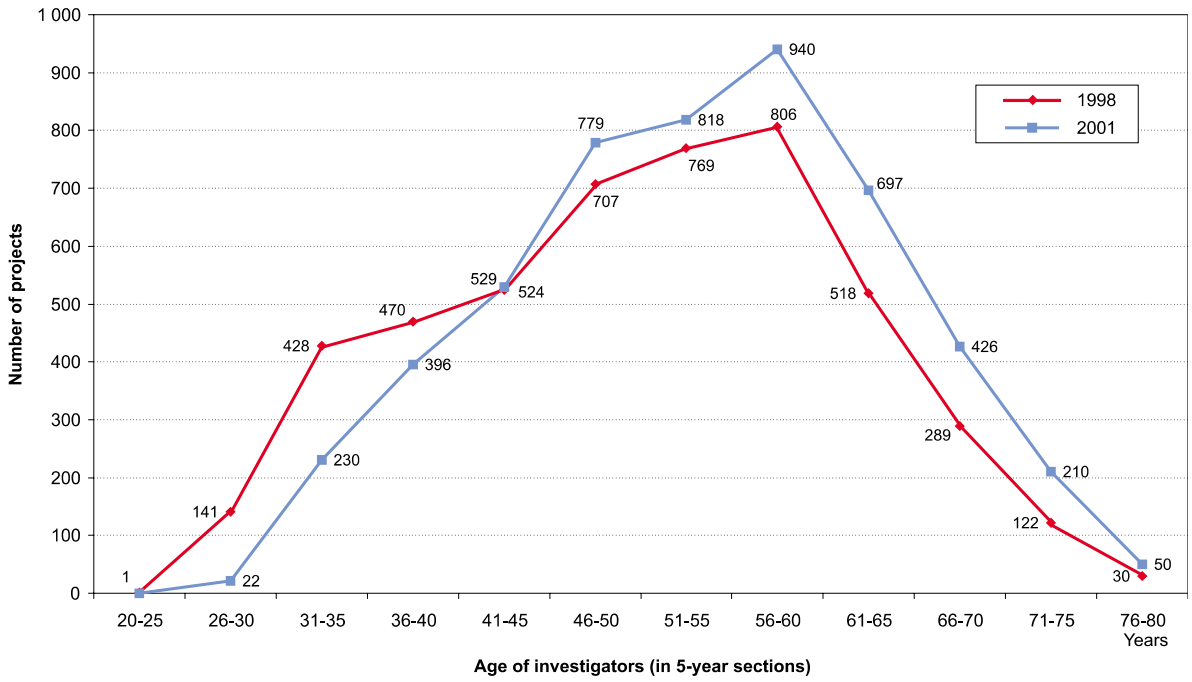


Source: Central Evidence of Research and Development Projects (CEP)

Commentary

1. With respect to universities, a slight increase of the number of projects and the amount of support provided via public tenders may be observed between 1998 and 2001, an average volume of projects remains the same.
2. With respect to the institutes of the Academy of Sciences of the Czech Republic, the number of projects declined between 1998 and 2001, however the amount of support increased and projects are larger and more complex.
3. With respect to the resort research institutes, between 1998 and 2001 the number of projects increased and the amount of support descreased – the trend is exactly opposite to that of the institutes of the Academy of Sciences of the Czech Republic, i.e. the projects are smaller and more fragmented.
4. With respect to non-state organisations – legal entities and natural persons, the number of projects increased slightly and the amount of their support increased substantially, the projects are larger and more complex.
5. For the first time in 2001 the representation of so-called consortia in which more than one investigator solve the same problem increases to a more substantial proportion. It is also due to establishment of the Research Centres Programme.

C 1. 5. Age of R&D principal investigators between 1998 to 2001

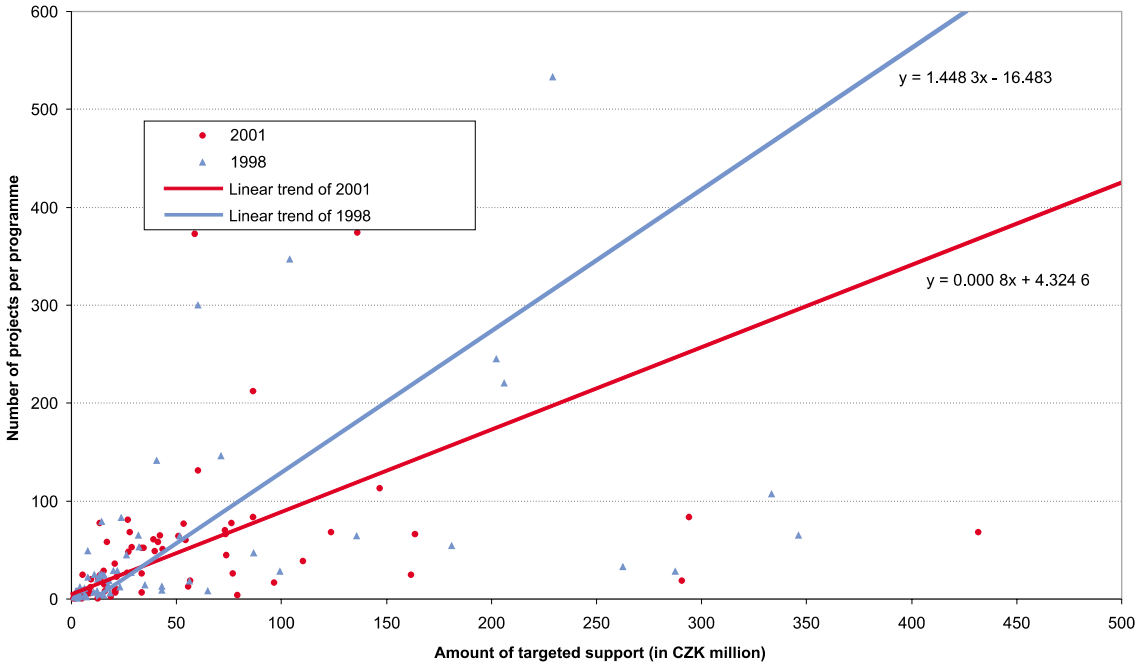


Source: Central Evidence of R&D projects (CEP)

Commentary

1. The mean age of principal investigators of projects in the Czech Republic has not practically changed and remains around 50 years.
2. The graph essentially corresponds to the standard stratification by age where however – compared with the situation in 1999 – the number of principal investigators increased with the exception of a category between 41 and 45 years. Unfortunately, the trend of the previous period, when the number of principal investigators below 40 years increased, did not continue.
3. The difference from the corresponding data abroad, where the number of investigators above 40 years substantially decreases, is very pronounced. In the Czech Republic the representation of a category between 73 and 80 years is not inconsiderable and in particular cases you can find investigators who are even older. It is probably the result of differences of the Czech system which combines the targeted and institutional financing. Targeted financing (particularly grant funds) abroad is used mainly by young researchers who are not yet included into the official structures of research organisations of state and private sector.

C 1. 6. Mean size of R&D programmes between 1998 and 2001

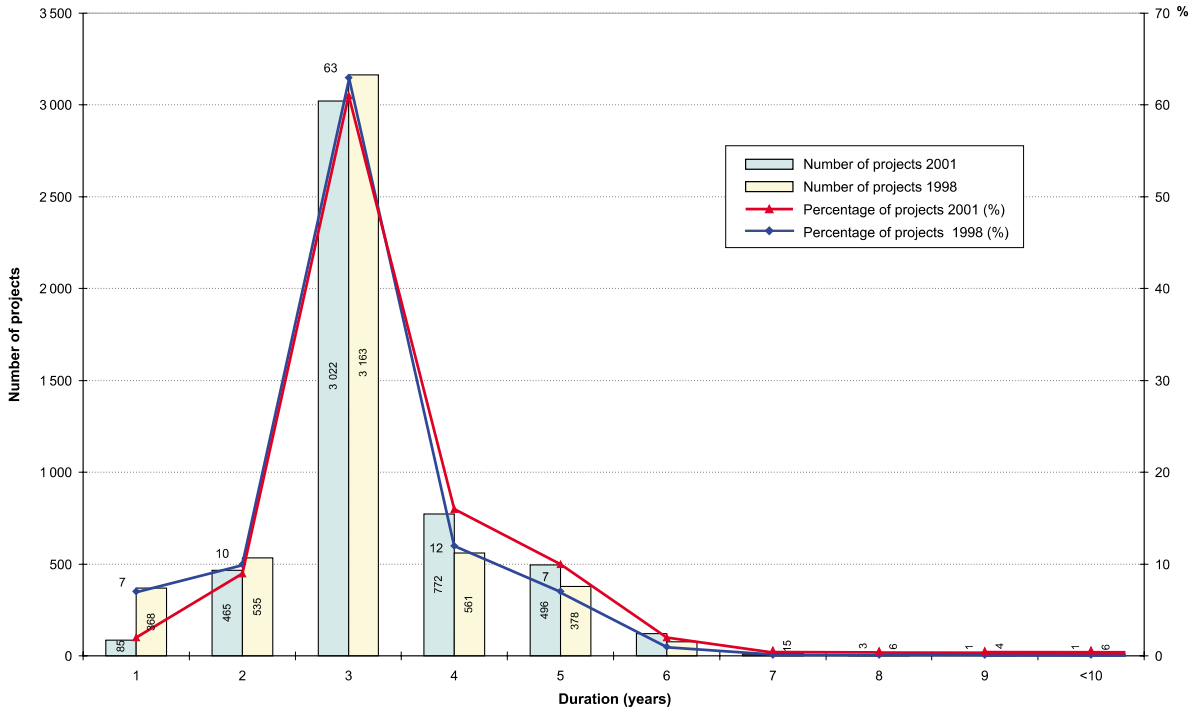


Source: Central evidence of R&D projects (CEP)
Note: Programme is put to tender by the relevant ministry (together with its objectives, terms etc.). Individual applicants submit projects covering a part of the promulgated programme objectives. The above graph shows the correlation between a number of projects in individual programmes and the level of targeted support of this programme, i.e. each dot represents one programme.

Commentary

1. Data of 1998 remained practically the same in 2001 – more than 50% of programmes contain less than 15 projects, one third of programmes less than 10 projects and one quarter less than 5 projects. Accordingly, the distribution of the correlation between a number of projects and the amount of the support is obvious – most programmes contain only a small number of projects and the project costs are low.
2. Despite this situation a certain shift may be observed between 1998 and 2001. As the directives show the tendency towards the programme characterised by larger support and less number of projects is evident.
3. Large national R&D programmes, common in the developed countries, are missing in the Czech Republic. National R&D Programme of the Czech Republic is only under preparation.

C 1. 7. Number of R&D projects and their mean duration between 1998 to 2001



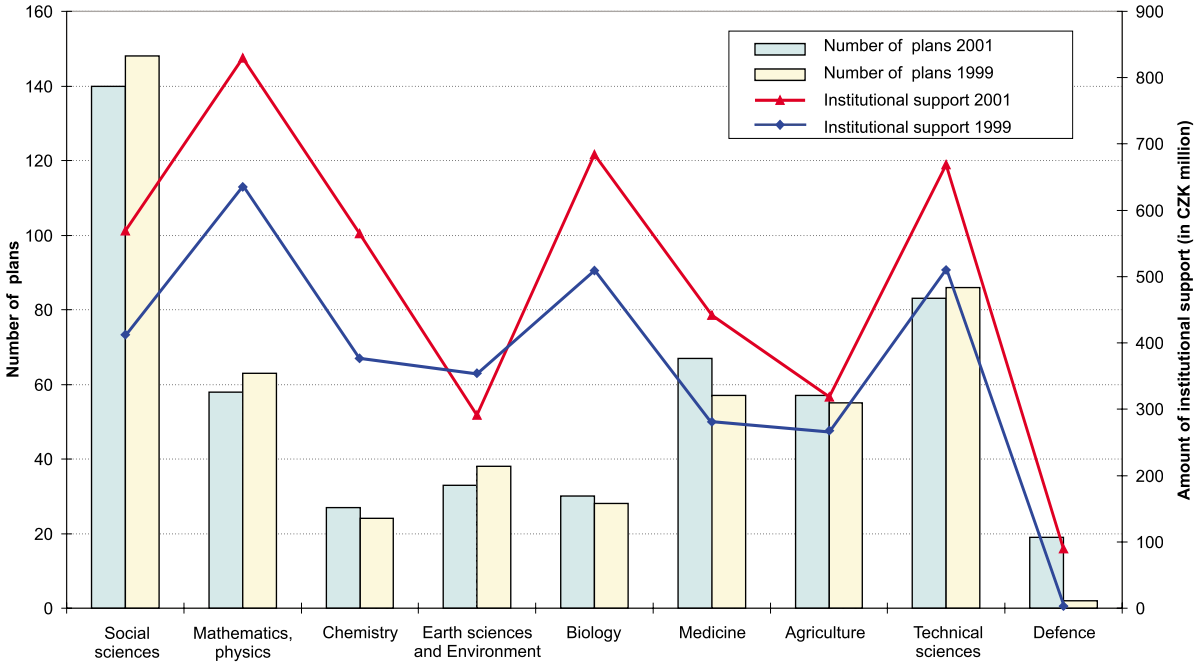
Source: Central Evidence of Research and Development Projects (CEP)
Note: The project duration is given by the date of commencement and the completion date as agreed in the contract regulating the support of the project solution. Percentage of projects is a proportion of a number of projects to the whole number of projects expressed in %.

Commentary

1. The on-going trend lasting since 1995 – trend of still more frequent three-year projects, not only with respect to the grant agencies but also with respect to the programmes (their share increased by 15 % in 1998 in comparison with 1995 and by further 5 % between1998 and 2001).
2. Projects lasting in excess of seven years the number of which is very low but still increases shall be re-assessed and their potential continuation reconsidered.

C 2. ANALIYSIS OF RESEARCH PLANS (CEI)

C 2. 1. Classification of research plans by sectors between 1999 and 2001

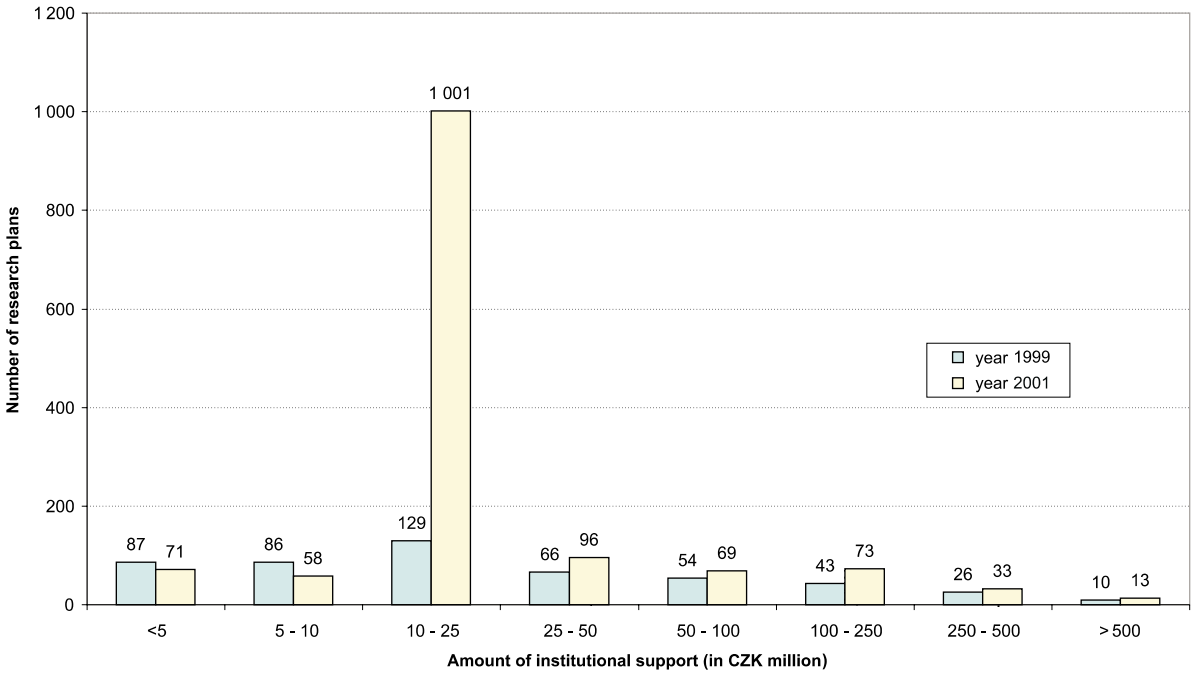


Source: Central Evidence of Research and Development Plans (CEI)

Commentary

1. Number of research plans between 1999 and 2001 changed only very little, the solution of five-year research plans commenced in 1999 which form more than 95 % of the total number of research plans still goes on.
2. Mathematics and physics draw the most of the institutional support of R&D due to the requirements on instrumentation, biology and technical sciences follow. The institutional support in these sectors grew in the same rate between 1999 and 2001.
3. The largest number of research plans and also high costs on social sciences – in comparison with the situation abroad – are remarkable. The costs of research plans solutions further increased between 1999 and 2001 and in mathematical terms it is more than 12 % of the total institutional support of research plans. In developed countries this share ranges up to 5 %. It may be in part attributed to the development of some, previously neglected social disciplines after 1989.
4. Institutional support devoted to medicine, chemistry and agriculture also increased between 1999 and 2001.
5. The only sector in which the amount of support declines is the Earth Sciences and Environment which is due to the preference of targeted support by the Ministry of Environment.

C 2. 2. Number of research plans classified pursuant to the amount of institutional support between 1999 to 2001

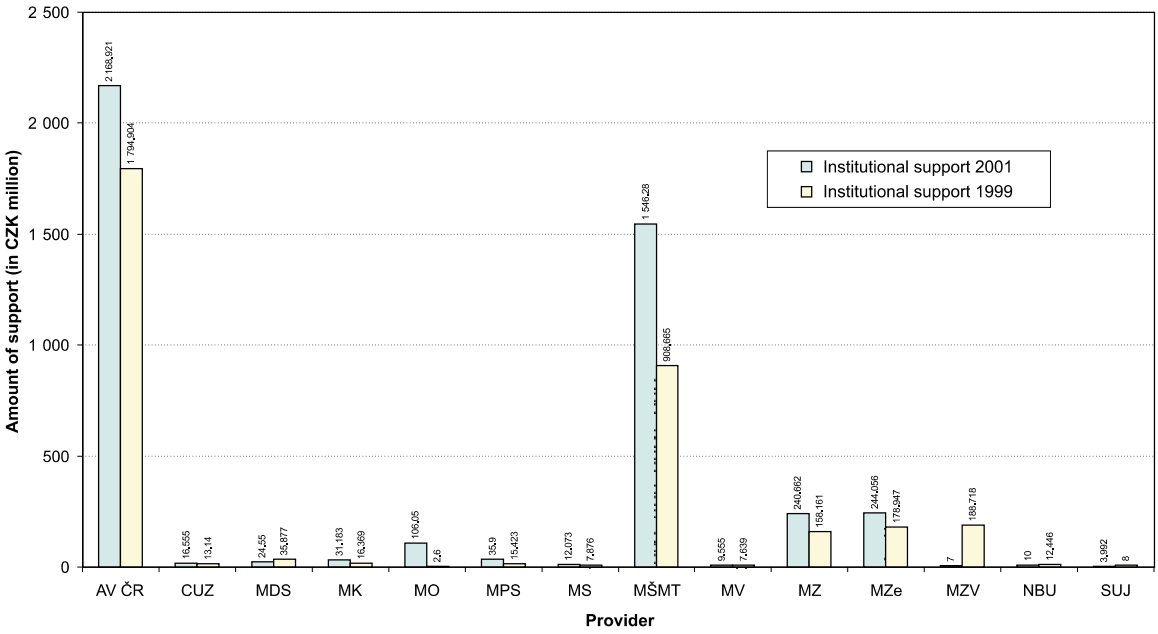


Source: Central Evidence of Research Plans (CEI)

Commentary

1. The prevalence of smaller research plans over those which are larger and more complex is evident from the Figure. A number of small plans characterised by the support in the amount of up to CZK 10 million slightly declined, on the other hand a number of plans with the support in the interval of CZK 10 to 25 million increased substantially.
2. A number of very small research plans (in a category up to CZK 500 thousand or up to CZK 1 million annually) is still alarming.
3. Despite a certain improvement we can still observe undesirable condition which implies that the research plans in many cases do not fulfil its mission which rests in the solution of the fundamental issues of institutions and their inter-resort assessment regulated by Act No. 130/2002 Coll. for plans commenced since 2004.

C 2. 3. Institutional support of research plans classified pursuant to the providers

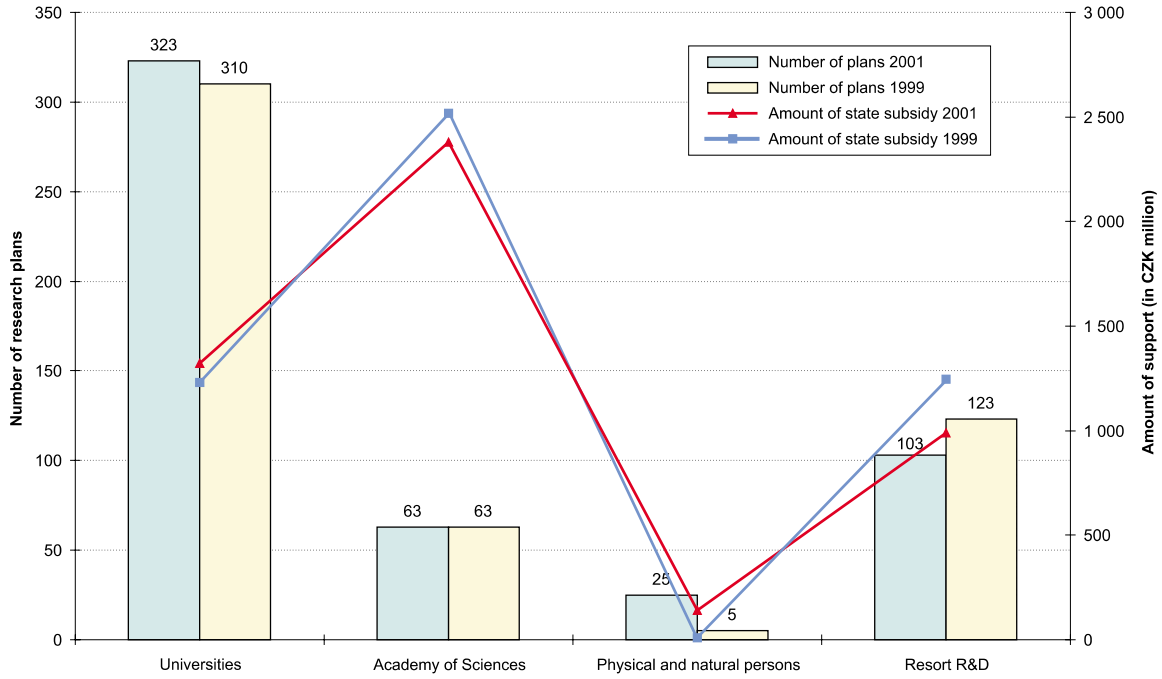


Source: Central evidence of research plans (CEI)
Note: AV ČR = Academy of Sciences of the Czech Republic, CUZ = Czech Surveying and Cartographic Office, MDS = Ministry of Transport and Communications, MK = Ministry of Culture, MO = Ministry of Defence, MPS = Ministry of Labour and Welfare, MS = Ministry of Justice, MŠMT = Ministry of Education, Youth and Sport, MV = Ministry of Interior, MZ = Ministry of Health, MZe = Ministry of Agriculture, MZV = Ministry of Foreign Affairs, NBU = National Security Authority, SUJ = State Nuclear Safety Office.

Commentary

1. The largest provider of institutional support is the Academy of Sciences of the Czech Republic and its support is directed to the research plans of the Academy of Sciences institutes. In this sphere the increase of support volume between 1999 and 2001 is not so high as with respect to universities but it is considerable in comparison with resort research institutes.
2. The second largest provider of institutional support is the Ministry of Education, Youth and Sport and practically exclusive recipients of the research plans support are universities. The largest increase of support between 1999 and 2001 was experienced by the universities. This increase at least partly approximated research at the universities to its position in developed countries.
3. Other resorts provide substantially smaller support to their institutes, however the amount of support of most of them increased between 1999 and 2001.

C 2. 4. Number of research plans and the amount of their institutional support classified pursuant to the categories of recipients between 1999 and 2001

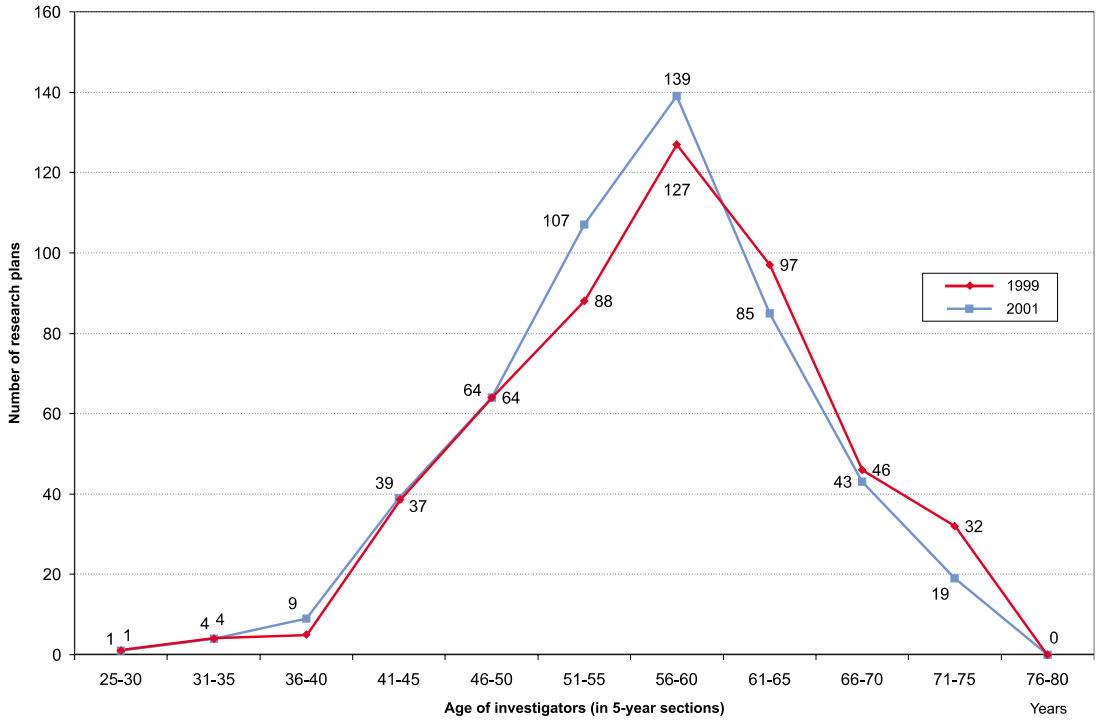


Source: Central Evidence of Research Plans (CEI)

Commentary

1. The classification of the amount of support corresponds to the previous Figure considering that the institutional support is provided by the resort to the institutions in its competence.
2. With respect to universities, there is a large number of research plans characterised by substantially lower average support than in case of other institutions. Research plans of universities are small, fragmented in many cases and insufficiently interconnected in the framework of a particular university.
3. With respect to the Academy of Sciences of the Czech Republic, the situation is opposite, when a substantial amount of support is provided to one research plan (mostly an plan of the whole institute irrespective of it volume). Particularly in case of large institutes the research plan becomes too general lacking any concrete aims of solution.
4. Unlike the previous two sectors the proportion of a number and volume of research plans in resort institutes is balanced.
5. Legal entities do not represent business sector but various associations, joint workplaces and other forms of combination of previous types of subjects.

C 2. 5. Age of principal investigators of research plans between 1999 and 2001



Source: Central Evidence of Research Plans (CEI)

Commentary

1. The mean age of a principal investigator of a research plan is approximately 7 years more than the mean age of a principal investigator of a project and did not substantially changed in the period in question.
2. As well as in case of projects the largest number of investigators fall into the category of 56 to 60 years.
3. There is a substantial difference in comparison with the projects the investigators of which are in categories below 40 (not practically represented), which corresponds to the similar data abroad.
4. In the Czech Republic the share of the category of 73 to 80 years is considerable and in certain cases the principal investigators are even older. It is only a further illustration of the fact that the Czech research grows old.

C 3. ANALYSIS OF R&D RESULTS (RIR)

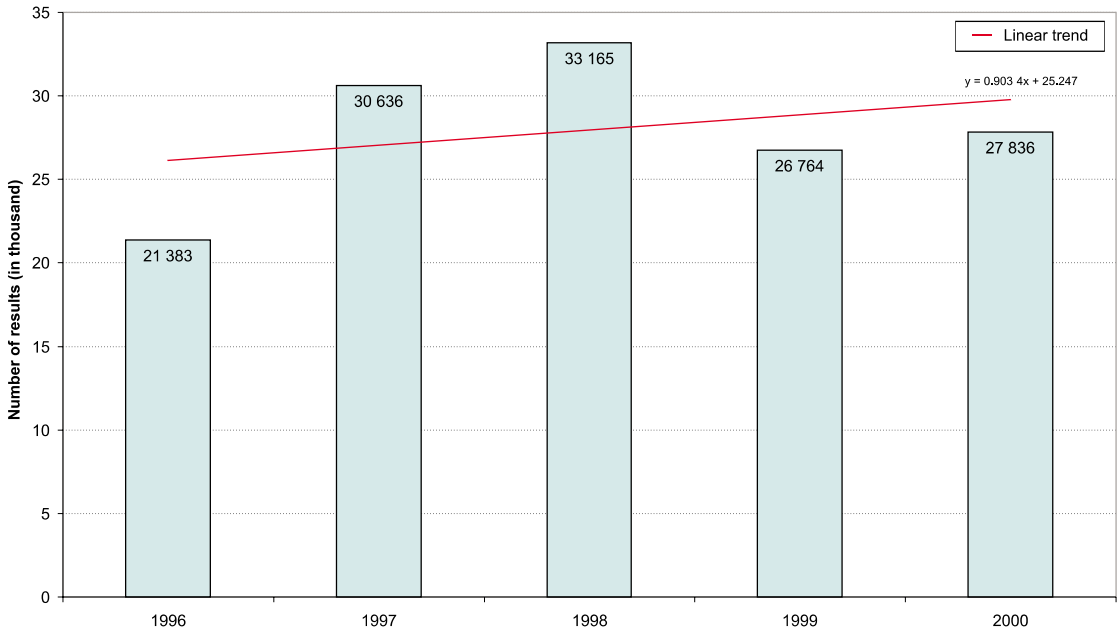
Register of Information on Results (RIR) was established in 1996 as a register of information on publications (RIP) to which other kinds of results (patents) were added and it was renamed to RIR.

The Register still distinguishes between the year of data collection (i.e. the year in which the resorts provide the data in the agreed-upon structures to the RIR) and the year of implementation (i.e. the year when the result was published), protected pursuant to special regulations (particularly to the patent law) or put into practice (in case of technologies). In the following text the exclusive classification pursuant to the result implementation is used (mostly, but far not always it is a year preceding the year of data collection – e.g. an article was published in 1998 and in 2000 it was provided and included into RIR).

The linkage between the results and projects or research plans may be divided into three periods. In the first one (data collection 1996–7) this information was not registered, i.e. the data provided in this period can be classified only pursuant to the resorts etc. In the second period (data collection 1998-9) the possibility to monitor these links was offered in the data structure only optionally and in practice was implemented only for the preparation and assessment of research plans (which commenced at that time). Only in the third period (data collection 2000–01) this linkage was compulsory for projects completed in 1999 and later. It was due to the unclear legal regulation and disagreement of most resorts to monitor the results of project solutions in RIR. This resulted in the situation when only around 20 % of results included in RIR are tied to particular projects.

The above-mentioned problems were gradually resolved by new legal regulations (at first only partly by the Regulation of the Government No. 88/2001 Coll., as amended by the Regulation of the Government No. 374/2001 Coll., and now in its entirety by the Act on Research and Development Support) where both the corresponding terms are defined (result implementation etc.) and the procedures of result inclusion described. In order to assess programme results (project, plan etc.) §31 6) of Act No. 130/2002 Coll. (Act on Research and Development Support) newly includes the duty to transfer all results (i.e. implemented and unimplemented – the envisaged implementation must be mentioned in this case) within no more than 250 days and following the implementation or unrealised implementation to update the data.

C 3. 1. Number of registered R&D results implemented in individual years between 1996 and 2000

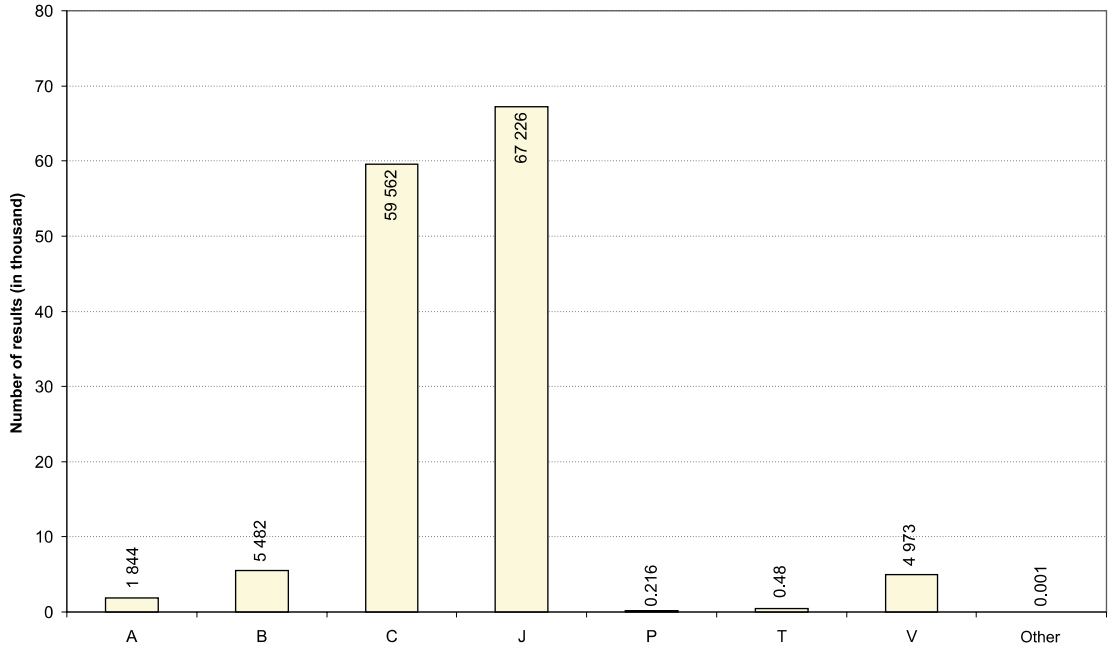


Source: Register of Information of Results (RIR)

Commentary

1. This graph records a total number of results registered in RIR between 1996 and 2000 irrespective of whether there is a link with completed projects or not.
2. Substantial decrease in 1999 (from 1996 to 1998 it was a constant increase) was due to the fact that the results collected in the previous period were included into RIR and new ones only started. In fact the graph expresses the trend free from this influence.
3. Quantitative comparison of a number of registered results (i.e. irrespective of their quality) with the growth of the total research and development support in the same period (see part B) shows that the support was increasing much faster than the number of results. It was particularly due to two factors. The first and more important is a substantially low research and development support namely in the first half of the 1990s when the insufficient research and development support devoted from public funds lead to the decline of a number of results several years later. The other factor is a small pressure on the return of invested funds which has begun to increase only in recent years. Besides, there exists a general factor of a certain lag of implementation of results mentioned in the introduction.

C 3. 2. Number of registered research and development results implemented between 1996 to 2000 classified pursuant to the type of the result

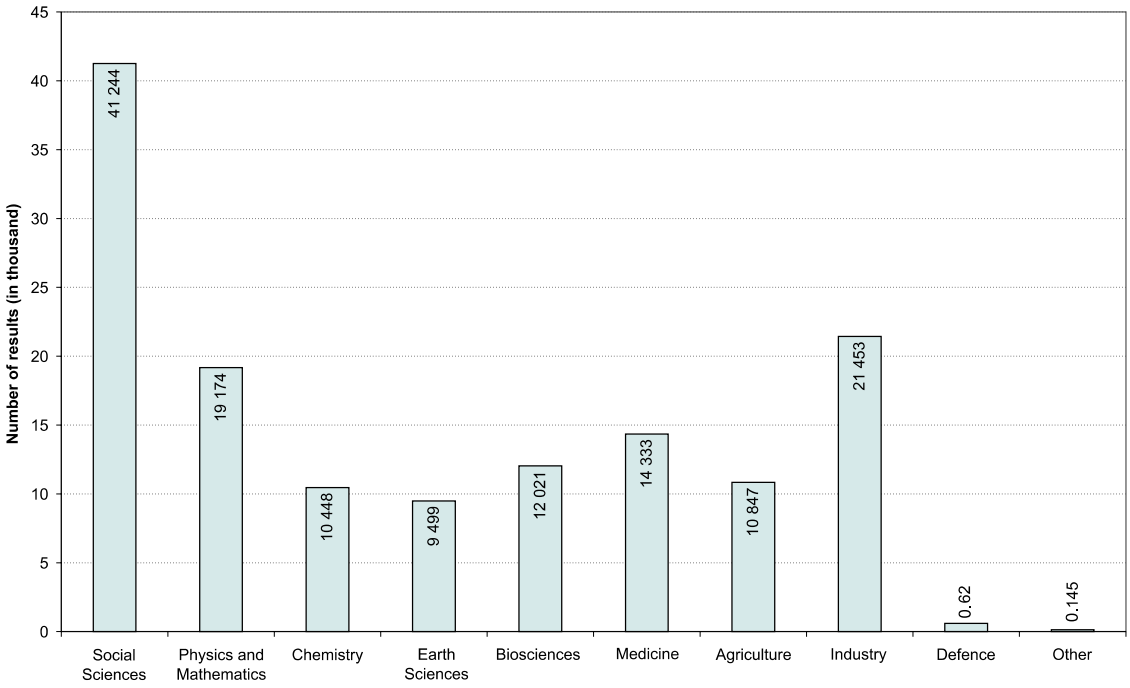


Source: Register of Information of Results (RIR)
Note: Explanations in the commentary.

Commentary

1. This graphs depicts the total number of results registered in RIR between 1996 and 2000 irrespective of whether there is a link with the completed projects or not, classified pursuant to the type of result.
2. According to the expectations, the most frequent type of the result is an article in the professional periodical (J) followed by the chapter in a book or an article in the proceedings (C). Particularly in case of those types of outputs it is necessary to distinguish their quality and to tighten the conditions; the large number of publications does not correspond to their contribution to the world knowledge assessed in Chapter D.
3. A small number of applied research results – technologies, prototypes, pilot plants, verified technologies (T) and patents (P) – in comparison with the amount of support is surprising and worrying.
4. A large number of unpublished research reports (V) is also surprising due to the fact that it greatly exceeds the research support for the needs of state administration, where the report is a standard form of an output.
5. Relatively large number of outputs included into the category of a presentation (A) does not correspond to a relatively small impact of research and development on professional and broad public. However, the methodological changes in the stipulation of the term "presentation" in the examined period must be considered.

C 3. 3. Number of registered research and development results implemented between 1996 and 2000 classified pursuant to the sections and sectors

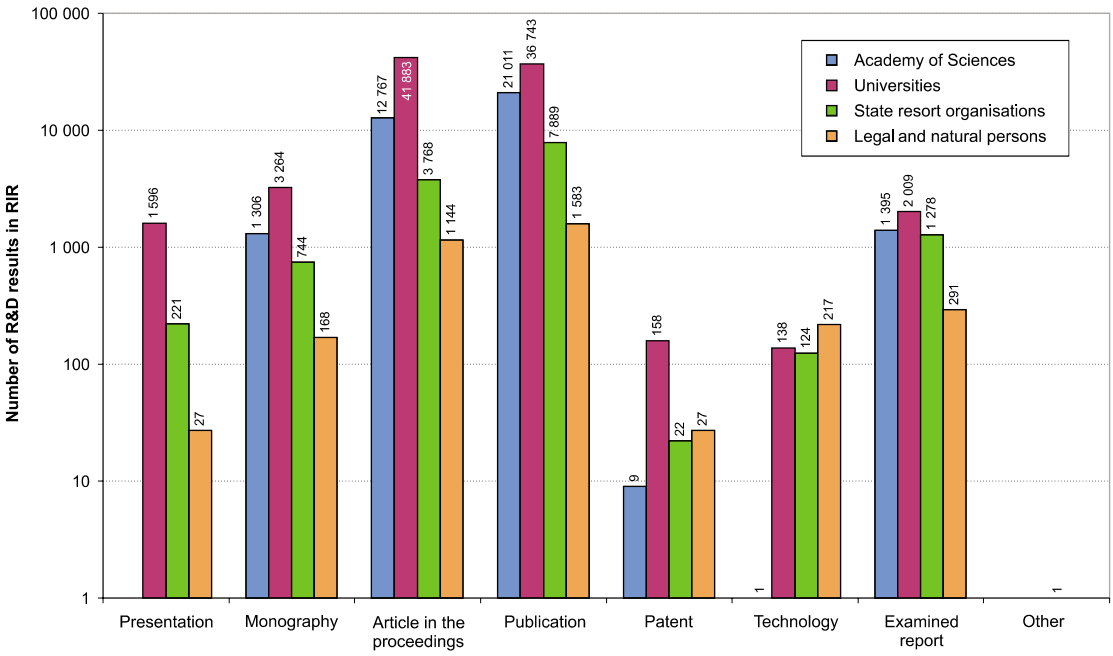


Source: Register of Information of Results (RIR)

Commentary

1. This graph depicts the total number of results registered in RIR between 1996 and 2000 irrespective of whether there is a link with the completed projects or not, classified pursuant to the type of the result.
2. The largest number of results comes from social sciences and substantially exceeds other sectors. Due to the fact that those results do not correspond to their contribution to the world knowledge assessed in Chapter D, partial results characterised by small impact are presumably included into RIR.
3. The second largest number of results is in industry. Due to the fact that the prevalent majority of those results are publications (see the preceding graph) it certifies of either an erroneous classification or a theoretical orientation of research in the Czech Republic. Foreign analyses and repeated comments of the European Commission certify the latter possibility.
4. With a view to a relatively high (compared to the similar countries) support provided to the defence sector a low number of results is surprising.

C 3. 4. Number of registered R&D results classified pursuant to the categories of recipients and the type of the result

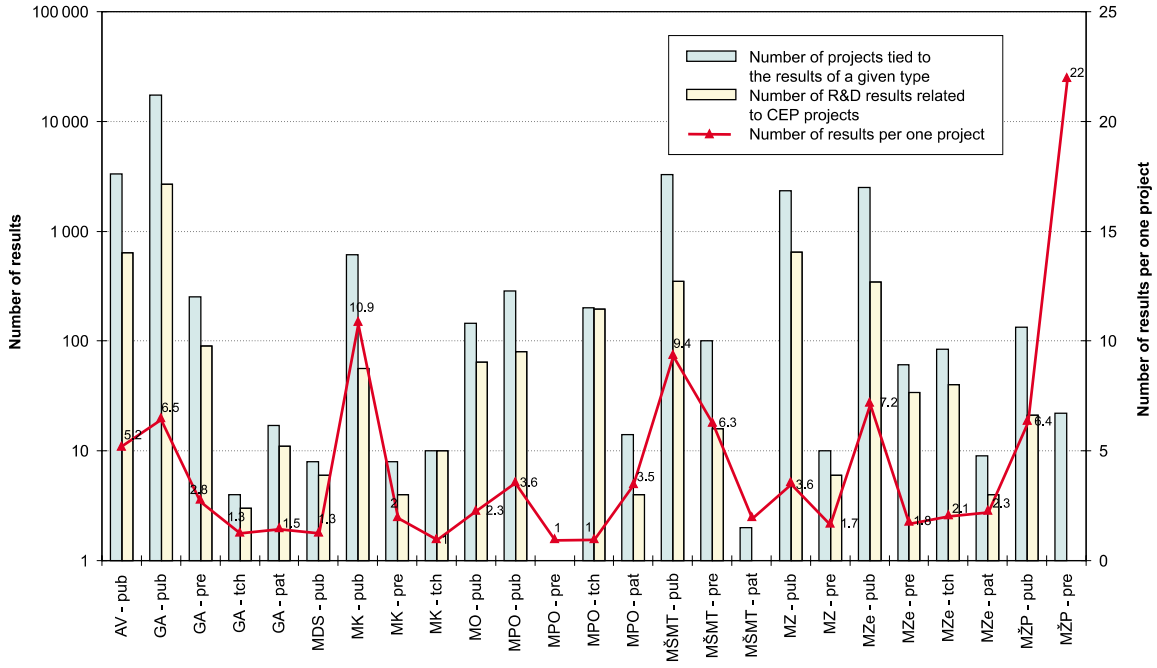


Source: Register of Information of Results (RIR)

Commentary

1. The total number of results registered in RIR between 1996 and 2000 is shown irrespective of whether there exists a linkage to completed projects or not, classified pursuant to the categories of recipients and the type of the result.
2. All types of results are represented (except the institutes of the Academy of Sciences where the technology and presentation are absent) in all categories of recipients.
3. Substantially higher number of articles in professional periodicals (J) and chapters in books or articles in proceedings (C) with respect to universities than with respect to the institutes of the Academy of Sciences is caused by less demanding requirements laid on their quality in case of universities.
4. Large number of articles in professional periodicals (J) and chapters in book or articles in proceedings (C) in business sector (legal and natural persons) is also interesting. However here it is due to the fact that research institutes privatised at the beginning of 1990s in which this sort of research has a tradition successfully applied for public support.
5. With a view to a large number of technically oriented universities a small number of outputs in the form of technologies, prototypes, pilot plants, verified technologies (T) and patents (P) is worrying. It also indicates that the specialisation of oriented research is too theoretical.
6. Large number of research reports in resort research institutes is alarming, though in most cases this research does not serve state administration needs.

C 3. 5. Registered R&D results tied to CEP projects

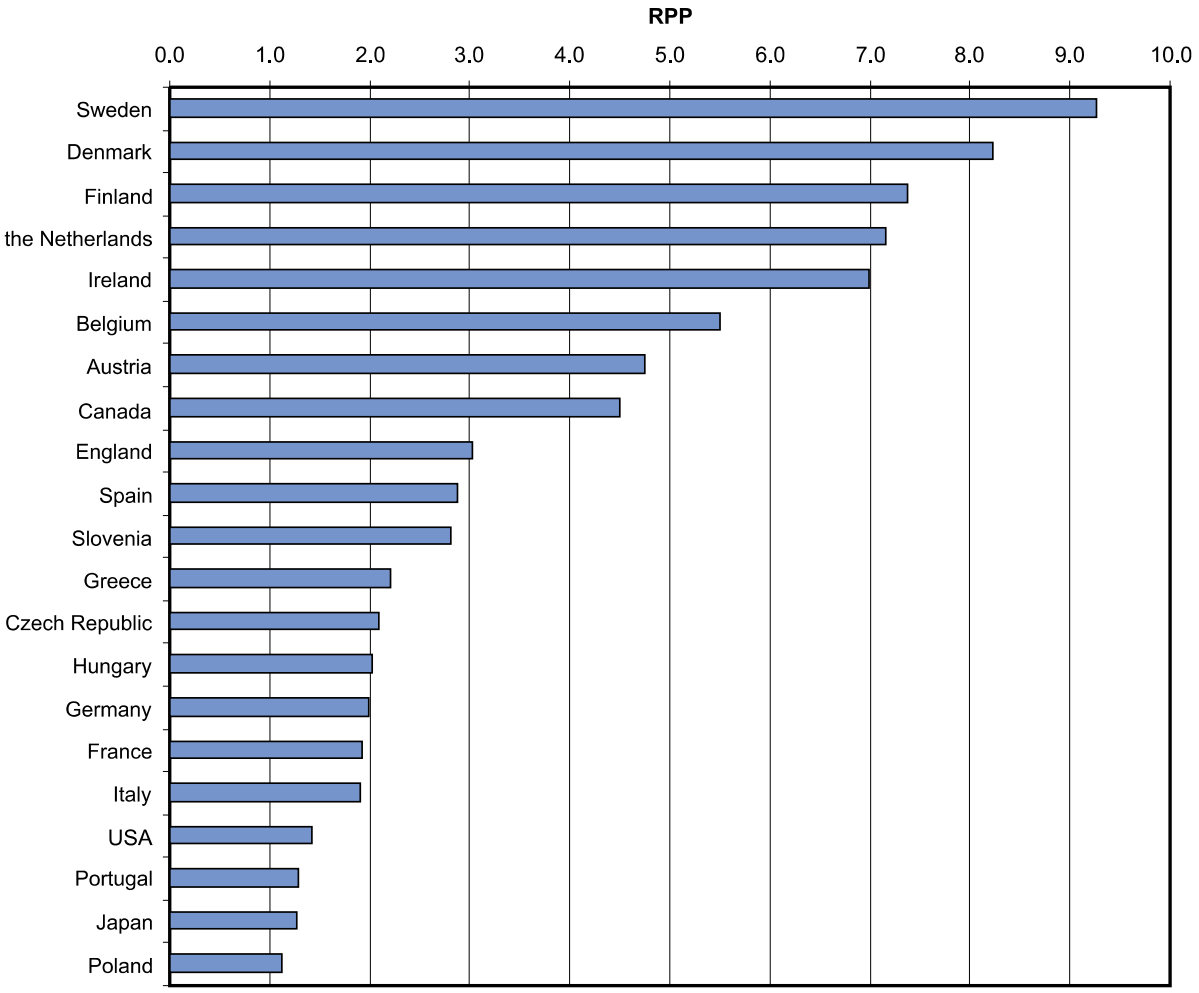


Source: Register of Information of Results (RIR)
Note: AV ČR = Academy of Sciences of the Czech Republic, GA = Grant Agency of the Czech Republic, MDS = Ministry of Transport and Communications, MK = Ministry of Culture, MO = Ministry of Defence, MPO = Ministry of Industry and Trade, MŠMT = Ministry of Education, Youth and Sport, MZ = Ministry of Health, MZe = Ministry of Agriculture, MŽP = Ministry of Environment, pub = publication, pre = presentation, tch = technology, pat = patent.

Commentary

1. Unlike the previous graphs in this Chapter, this one shows only the selection of those results of the period 1999 to 2000 which are related to the completed research and development projects. In previous years the relation between the completed projects and research and development results was not monitored.
2. These data cover only two years and therefore it would be premature to draw general conclusions; a number of results has not been implemented (published etc.) yet. Nevertheless, the graph provides interesting information completing previous graphs.
3. This graph differs from the previous ones, showing the total number of results registered in RIR between 1996 and 2000 irrespective of whether there is a link to completed projects, primarily in certain resorts (e.g. in case of the Academy of Sciences the only output is a publication). It is probably due to a short time interval of this way in monitoring research and development results.

D 1. Relative production of publications in selected countries, 1995–1999



Source: Web of Science, ISI Thomson Scientific, Main Science and Technology Indicators, OECD 2001/2
Note: Relative publications production (RPP) indicates the number of publications per 10 000 inhabitants in a given period.

Commentary

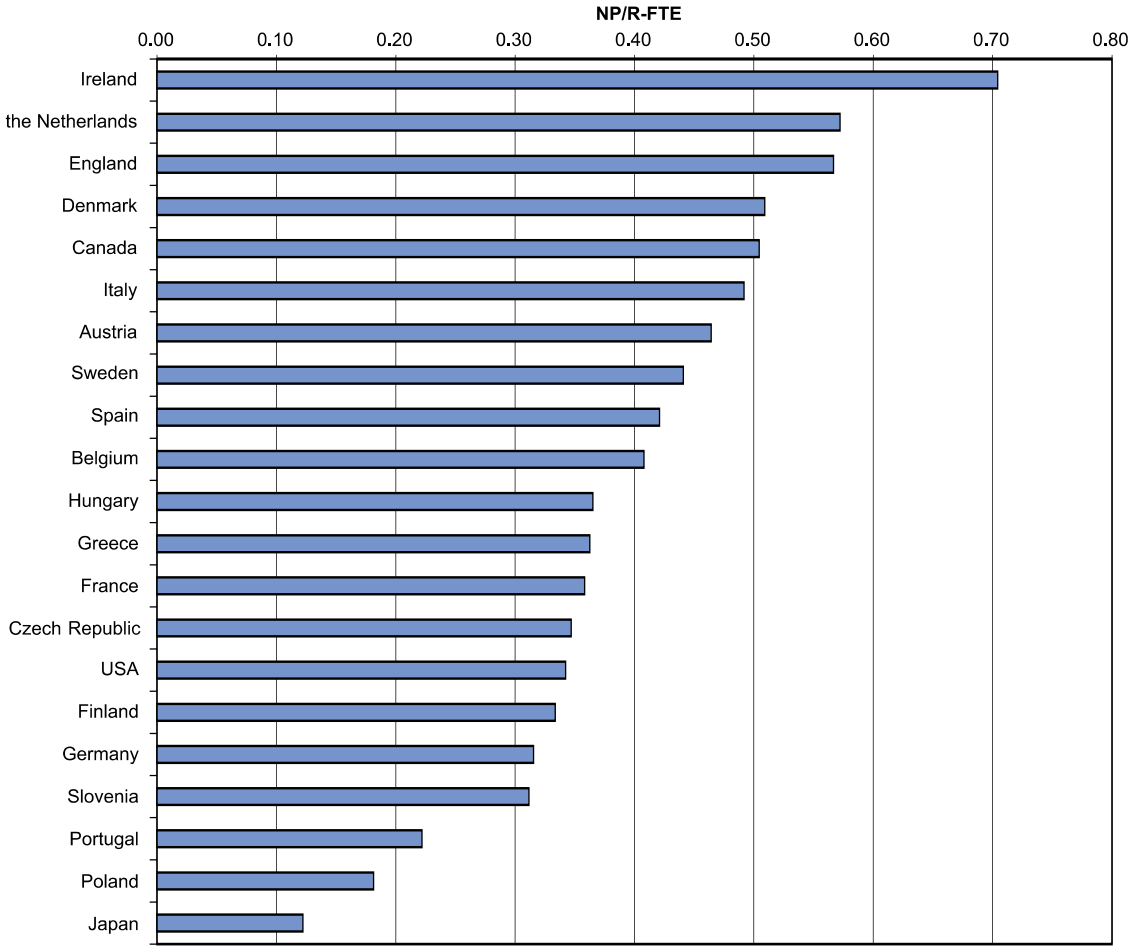
1. The publications production indicator enables one to compare bibliometric outputs of that part of research of a particular country the main result of which is a new knowledge diffused through a research publication. In this case smaller countries are handicapped. Therefore it is more just to implement for the purposes of comparison of individual countries the relative publications production indicator, as it introduces a correction for country size and number of its inhabitants.
2. Pursuant to RPP the Czech Republic is compared in the group of 21 selected countries which include EU countries, G 7 countries and four selected countries from the group of countries associated to EU (AEU). These are Czech Republic, Poland, Hungary and Slovenia.

3. For the monitored period between 1995 and 1999, according to RPP the Czech Republic assumes 13th place among the 21 countries included in the selection. It is by 5 places better than in the previous period between 1994 and 1997. The Czech Republic outpaced not only the countries of the same fate (Hungary and Poland of AEU countries), but has reached the level of developed EU countries (Germany, France and Italy).
4. The value of RPP indicator is remarkable in Scandinavian countries (Sweden and Finland) and in relatively small countries (Belgium, the Netherlands and Ireland), which more than doubles the value of the same indicator corresponding to the average of EU countries. These are countries having developed fully functional scientific system which together with a quality management and effective financing enables them to attain over-average results not only in the sphere of basic research. With regard to the RPP indicator countries having more inhabitants (USA, Japan) and economy-oriented research are handicapped.
5. Comparison of selected groups of countries and the Czech Republic according to relative publications production.

Country	Relative publications production
G7	2.3
EU	4.6
AEU	2.0
Czech Republic	2.1

According to RPP the Czech Republic is in its group (AEU) above the average, however in comparison with EU countries it attains only 45 % of the average RPP value for EU countries.

D 2. Annual productivity of publications of selected countries in 1999



Source: Web of Science ISI Thomson Scientific, OECD Main Science and Technology Indicators 2001/2
Data on the number of researchers of selected countries refer to 1999 except Ireland, Italy and USA (1997) and Austria and England (1998). The data provider warns that the USA data are strongly underestimated.
Note: Annual publications productivity indicates the number of output units (publications) (NP) per the research capacity of a unit (number of researchers converted to a full-time equivalent – R-FTE) in the given year. On the horizontal axis: NP/R-FTE.

Commentary

1. Comparison of countries pursuant to their annual publications production indicator would be certainly more just than pursuant to the value of relative publications production indicator, which rectifies only the number of population. However, the increased uncertainty related to the collection of primary data on the number of researchers in a particular country due to the full-time equivalent results in the decreased homogeneity of statistical data and as a result increases the uncertainty of combined indicator value.
2. Ranked among the selection of 21 countries according to annual productivity of publications the Czech Republic assumes the 14th position. It is one position lower with respect to relative publications production.

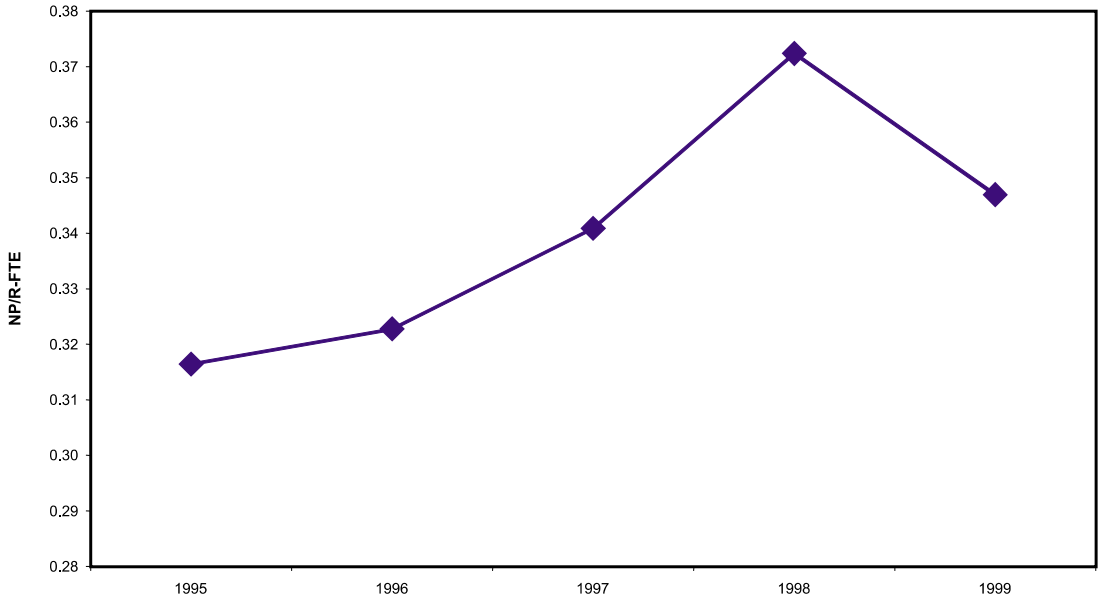
3. In the group of AEU countries the Czech Republic beats pursuant to the annual publications productivity Poland and Slovenia, which is with respect to relative publications production before us.
4. With an annual publications productivity value of 0.35 publication per one researcher Czechia keeps pace with other developed countries (France, Germany) as well as with Hungary, which is a little before the Czech Republic.
5. A lapse of Finland down to the 16th position of the 21 selected countries pursuant to the annual publications productivity is remarkable as Finland is one of the top countries pursuant to the relative publications production. The reason of this situation may be explained by the fact that Finland is a country with one of the highest total expenditures on research (3.19 % in 1999) which determine the magnitude of research in the country. Bibliometric studies carried out on the level of research teams show that favourable financial inputs into the basic research results in, on one side, the increase of a number of researchers, however on the other side, in the temporary decline of a simple publications production. This law applies probably also at the level of institutions and countries.
6. Ireland (0.7 publication per research) is at the top of the table of countries classified pursuant to the annual publications production, followed traditionally by the elite countries which in a long-term create favourable conditions for the operation of science on the high level and hi-tech research. These are countries having smaller (the Netherlands, Denmark, Austria) or larger (England, Canada or Italy) territory. The Czech Republic has a half annual publications productivity than the leader Ireland.
7. Annual publications productivity of selected countries in 1999

country	annual publications production 1999
G7	0.39
EU	0.44
AEU	0.30
Czech Republic	0.35

According to the annual publications productivity the Czech Republic attains the level of 80 % of EU countries average.

D 3. Annual publications productivity of the Czech Republic between 1995 and 1999

(dependence of the annual NP/R-FTE indicator on time)

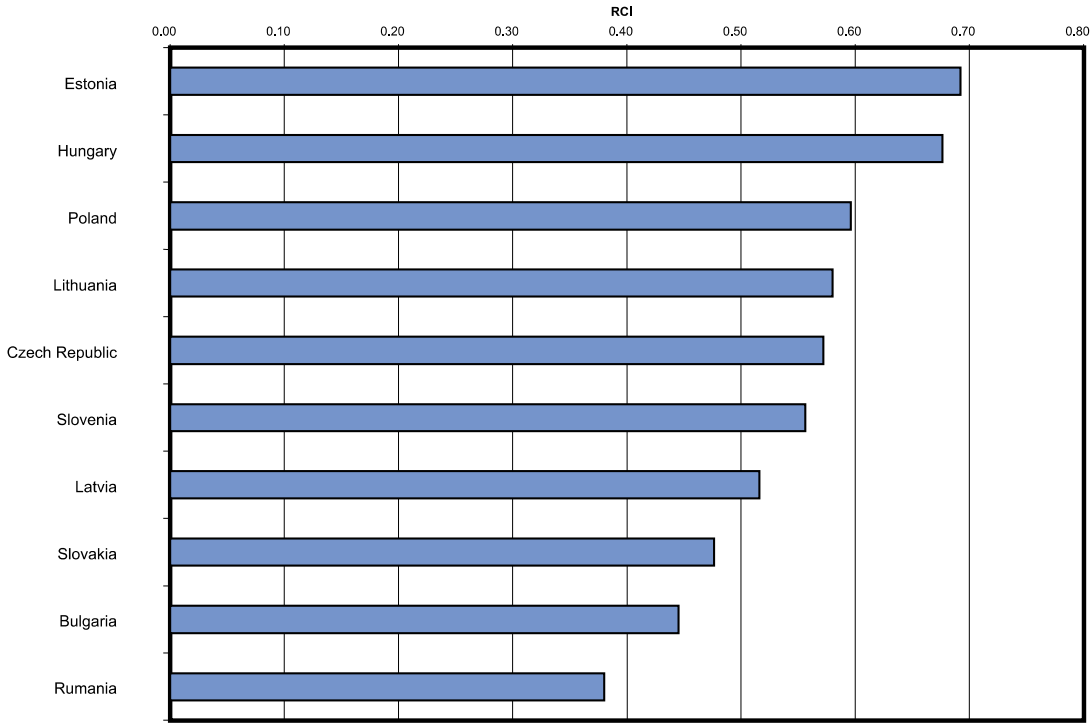


Source: Web of Science ISI Thomson Scientific, OECD Main Science and Technology Indicators 2001/2
Note: Annual publications productivity indicates the number of output units (publications) (NP) per the research capacity of a unit (number of researchers converted to a full-time equivalent – R-FTE) in the given year. On the vertical axis: NP/R-FTE.

Commentary

1. Time dependence of annual publication productivity in the Czech Republic reveals a slight increase of the indicator value between 1995 and 1998. It is a positive long-term trend which reflects the ever increasing publication activity of that part of research where a new knowledge spread by means of a scientific publication is a main output. It is predominantly basic oriented and non-oriented research and a part of applied research.
2. The increase of a number of publications is higher than the increase of a number of researchers even in the situation when the overall expenditures on research do not reach the required level.

D 4. Bibliometric quality of publications, 1995–1999



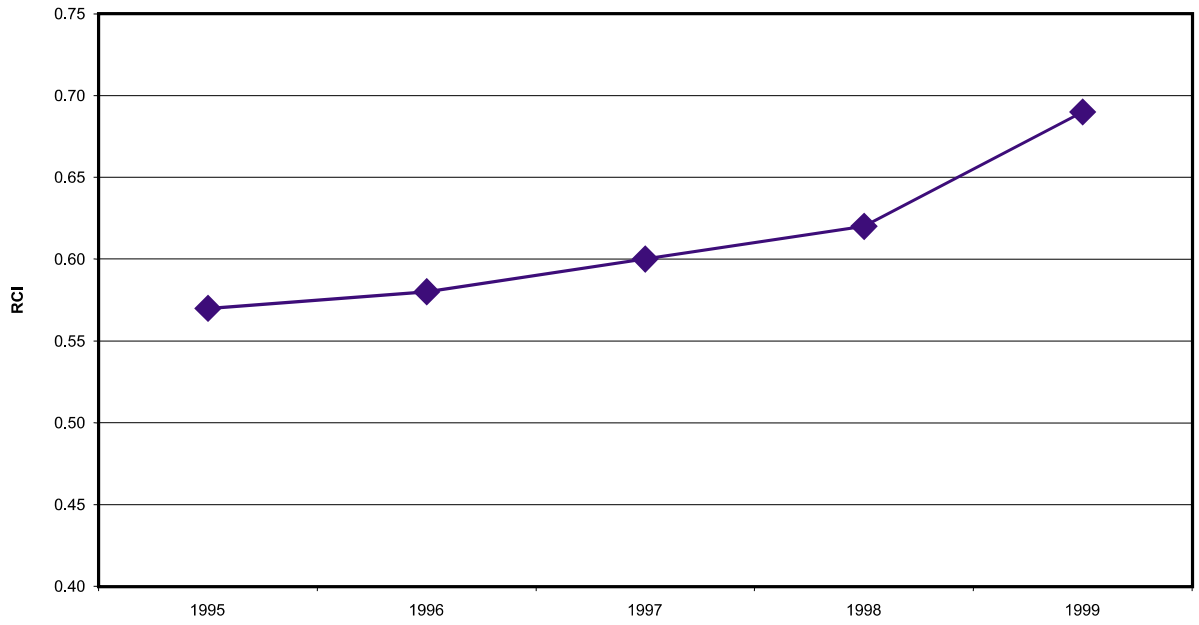
Source: Ryan Sheppard, ISI Thomson Scientific, presentation in Prague on February 2, 2001 on the occasion of the inauguration of ISI Web of Science
Note: Citation impact indicates the mean number of citations per publication. Relative citation impact (RCI) is the citation impact of a given country divided by the citation impact of the world base (baseline). RCI > 1 indicates that the rate of citations is higher than the "world average", RCI < 1 indicates that the rate of citations (bibliometric quality) is lower.
It is necessary to mention that the data on the citation impact mentioned in the applied alternative source are in case of the Czech Republic undervalued in the amount exceeding 10 %. It certifies the comparison of data on the number of publications (Czech Republic + Czechoslovakia) of NSIOD source to which the author referred at that time, to the data acquired from WOS.

Commentary

1. In analysis of 1999 in part D. Bibliometry the same graph D 3 is included, but with a different selection of countries and for the period between 1994 and 1997. In this graph, Czech Republic together with Slovenia assumed the last two positions in a group of 21 countries ordered according to decreasing value of RCI. RCI = 0.55 for the Czech Republic indicates that the bibliometric quality of publications in the country as a whole irrespective of the difference of disciplines was about one half that of the world average.
2. The Czech Republic lags not only behind Hungary and Poland but also behind Lithuania and Estonia.
3. Bibliometric analysis stemming from the group of selected countries in the period between 1995 and 1999 in aggregate provides approximately the same values of RCI for the above-mentioned countries as those reported between 1994 and 1997, and thus the same order of countries. It is possible to state that bibliometric quality of publications is in average approximately the same since 1994.
4. The Czech Republic ranks among the group of countries with RCI > 0.5. Latvia, Slovakia, Bulgaria and Rumania have an aggregate (average) RCI < 0.5.

D 5. Annual bibliometric quality of publications

(time dependence of the annual RCI indicator)



Source: Ryan Sheppard, ISI Thomson Scientific, presentation in Prague on February 2, 2001 on the occasion of the inauguration of ISI Web of Science
Note: Citation impact indicates the mean number of citations per publication. Relative citation impact (RCI) is the citation impact of a given country divided by the citation impact of the world base (baseline). RCI > 1 indicates that the rate of citations is higher than the "world average", RCI < 1 indicates that the rate of citations (bibliometric quality) is lower.

Commentary

1. Time dependence of a bibliometric quality of publications indicator (RCI) of the Czech Republic indicates that since 1995 a slight increase of the value is evident which in 1996 abruptly passes from 0.62 to 0.69. In the view of the high robustness of the RCI indicator the increase by 10.5 % is statistically relevant.

D 6 A. Czech scientific periodicals published in the Czech Republic and listed in JCR – 2000 data

(ordered according to relative rank in the corresponding group of periodicals)

Rank	Periodical	PIF	Max. PIF	Relative rank
1	Collection of Czechoslovak Chemical Communications	0.960	20.036	36
2	European Journal of Entomology	0.716	7.250	47
3	Physiological Research	1.366	27.677	53
4	Folia Parasitologica	0.844	6.724	57
5	Folia Geobotanica	0.649	15.094	59
6	Folia Microbiologica	0.752	13.810	61
7	Studia Geophysica et Geodaetica	0.761	7.895	62
8	Ceramics – Silikáty	0.167	2.017	64
9	Československá psychologie	0.295	6.913	69
10	Photosynthetica	0.482	15.094	70
11	Acta Veterinaria Brno	0.240	2.476	72
12	Rostlinná výroba	0.256	2.419	75
13	Chemické Listy	0.278	20.036	76
14	Veterinární medicina	0.188	2.476	79
15	Folia Biologica	0.351	9.249	80
16	Finance a úvěr	0.281	2.753	80
17	Czechoslovak Journal of Physics	0.298	12.774	84
18	Kybernetika	0.178	1.400	84
19	Folia Zoologica	0.240	3.772	85
20	Politická ekonomie	0.154	6.676	90
21	Czech Journal of Animal Science	0.172	1.823	91
22	Sociologický časopis	0.080	3.255	94
23	Česká a Slovenská Neurologie a Neurochirurgie	0.059	26.676	95
24	Acta Virologica	0.558	8.018	96
25	Listy cukrovarnické a řepařské	0.018	2.419	96
26	Czechoslovak Mathematical Journal	0.103	2.750	97
27	Filosofický časopis	0.069	1.487	100

D 6 B. Time dependence of the PIF indicator of Czech scientific periodicals between 1996 and 2000

Periodicals	1996	1997	1998	1999	2000
Acta Veterinaria Brno	0.120	0.132	0.288	0.227	0.240
Acta Virologica	0.481	0.454	0.500	0.476	0.558
Ceramics – Silikáty	0.207	0.098	0.152	0.208	0.167
Collection of Czechoslovak Chemical Communications	0.546	0.550	0.546	0.717	0.960
Czech Journal of Animal Science	0.000	0.000	0.000	0.195	0.172
Czechoslovak Journal of Physics	0.339	0.212	0.348	0.328	0.298
Czechoslovak Mathematical Journal	0.094	0.078	0.159	0.140	0.103
Česká a Slovenská Neurologie a Neurochirurgie	0.008	0.062	0.029	0.065	0.059
Československá psychologie	0.099	0.233	0.140	0.196	0.295
European Journal of Entomology	0.633	0.858	0.661	0.443	0.716
Filosofický časopis	0.041	0.009	0.103	0.063	0.069
Finance a úvěr	0.000	0.000	0.000	0.000	0.281
Folia Biologica	0.500	0.522	0.632	0.493	0.351
Folia Geobotanica	0.000	0.000	0.611	0.393	0.649
Folia Microbiologica	0.225	0.312	0.518	0.402	0.752
Folia Parasitologica	0.977	0.716	0.706	0.796	0.844
Folia Zoologica	0.407	0.364	0.314	0.182	0.240
Chemické Listy	0.186	0.159	0.108	0.190	0.278
Kybernetika	0.158	0.149	0.080	0.100	0.178
Listy cukrovarnické a řepařské	0.084	0.038	0.006	0.033	0.018
Photosynthetica	0.659	0.941	0.663	0.734	0.482
Physiological sResearch	0.532	0.807	0.616	0.521	1.366
Politická ekonomie	0.072	0.105	0.095	0.327	0.154
Rostlinná výroba	0.170	0.214	0.166	0.192	0.256
Sociologický časopis	0.103	0.283	0.320	0.255	0.080
Studia Geophysica et Geodaetica	0.000	0.000	0.000	0.000	0.761
Veterinární medicina	0.162	0.213	0.231	0.220	0.188

Source: ISI® Journal Citation Reports® (JCR)® – ISI Thomson Scientific product available as a multi-licence of the Ministry of Education, Youth and Sport programme
Definition of an indicator: Periodical Impact Factor (PIF) is defined as a ratio where the number of articles published in the assessed journal during the last two years (in our case 1998–1999) and cited in any journal included in the assessment in the given year (in our case 2000) is a numerator, and the denominator is the sum total of articles published in the assessed journal during the last two years.
PIF is a measure of frequency with which an "average article" is cited in a given year. Its value with respect to a given periodical is listed in the Table D 6 A. in column 3. It is possible to compare according to the PIF value only those periodicals which are included into the group of periodicals defining a particular discipline (bibliometric definition of a scientific discipline) to take into account specific features of publishing in individual disciplines.

The same principle as that used in bibliometric discipline analysis was used.
For the sake of comparison of bibliometric quality of periodicals from different disciplines the relative rank indicator (last column in Table D 6 A.) is used. This indicator value is a number ranging from 1 to 100 which stipulates the rank which the assessed periodical assumes in the group of other periodicals of the given discipline according to the weight granted by PIF. In column 4 the maximum value of PIF is listed which is attributed to the best periodical of the discipline. These values certify that there are substantial differences between individual disciplines in the manners of publication of research activity outputs.

Commentary:

1. ISI Thomson Scientific indexes 27 Czech periodicals (specialised scientific journals) out of the total of 2 504 periodicals published in 2000, which is 1.1 % (in 1998 it was 0.99 %).
2. In 2000 the Academy of Sciences of the Czech Republic edited 90 periodicals (in 1997 89 periodicals), of which 16 were impacted, i.e. mere 18 % (in 1997 it was 12 impacted periodicals, i.e. 13.5 %). It is obvious from this comparison that the quality of periodicals published by the Academy of Sciences of the Czech Republic has increased during the monitored period.
3. The number of impacted periodicals has increased from 21 in 1997 to 27 in 2000. Periodicals Kovové materiály and Živočišná výroba were excluded from the ISI measurement (PIF = 0 for the period of two years), but two new periodicals having a measurable PIF were added. Five of them come from the sphere of social sciences and the periodical Finance a úvěr published in Czech assumed in the relative rank the 16th position among Czech impacted periodicals.
4. The first two periodicals in the Table D 6 A. and European Journal of Entomology have the best relative quality out of Czech periodicals. The leading periodical Coll. of Czechoslovak Chem. Comm. has registered the biggest jump in the relative order. From the 64th position in 1997 to the 36th position in 2000. It ranked this journal among the quality international chemistry periodicals and its current PIF is even higher than in case of many traditionally prestigious foreign periodicals. The strict editorial policy introduced in 1998 brings its fruits.
5. European Journal of Entomology following the lapse of PIF value after 1997 assumes the 2nd position in the relative rank. Also the third periodical Physiological Research has improved its position in the international comparison (68th position in 1997 to 53th position in 2000).
6. Mean value of the rank of Czech scientific periodicals in the relative rank (1–100) of all world periodicals impacted by ISI Thomson Scientific was 80 in 1997 and 79 in the assessed year 2000. It is possible to say that the average standard of Czech scientific periodicals is at 20 % of the level of top (leading) scientific periodicals of all disciplines in the world.
7. The assessment of trends of time dependence of PIF (in the period 1996–2000) shows that 19 Czech periodicals (it is 70 %) preserves the stable standard of its PIF in the long run, 5 periodicals (it is 19 %) shows the tendency to improve the level and 3 periodicals (it is 11 %) oscillate on the verge of PIF measurability and they are threatened by possible exclusion from the process of quality quantification and their shift to indexed periodicals.
8. Some of the scientific periodicals assigned for the community of Czech experts which are published in Czech and with and English abstract (e.g. Finance a úvěr and Chemické listy which show an increase of PIF value) assume a very creditable place compared with other domestic periodicals published in world languages.

Annex: Bibliometry – sources and methodology

One of the primary outputs of scientific research activity is a new information. In this part of research where a new information is a final output it is usually published in publications and disseminated in the form of scientific research periodicals which together with other carriers form the scientific literature

Bibliometry (formerly bibliography) deals with the quantitative analysis of scientific literature.

Bibliometry is a quantitative method which is advantageously used for the assessment of publication output in that part of research where the publication is the main final product. Therefore it is one of the quantitative methods of assessment of ex post type. It is necessary to remind that bibliometry assesses only the publication output which is a product of intellectually challenging scientific research activity. However, the assessment of the research activity as such must be understood as a specified and aim-oriented system of activities implementing multiple criteria. However, the bibliometric approach as one of the many criteria must be implemented in assessing the research activity.

The citation indexes which are part of secondary literature are the source of data for bibliometric studies. The most famous is Science Citation Index (SCI) which is published since 1961 by ISI (Institute for Scientific Information, USA), now ISI Thomson Scientific.

SCI stems from the conception of E. Garfield on the mutual linkage between the citing and cited publication. SCI is characterised by the fact that it is a reference source principally impartial as it is formed without the intervention of a human subjective factor.

The forms of making SCI available reflected the progress in the level of information and communication technologies and passed both the printed and electronic form. At present the most important and by far the most effective form of SCI is an ISI product Web of Science, which implements the combination of citation indexing and the capacity of WEB service based on the Internet. This product was put to the market in April 1997 and since then it is acknowledged by the world information community as a very lively and completely extraordinary tool of scientific research.

It serves predominantly, on one side, as an information input into research (literature search conducting) which enables a direct access to the primary literature in an electronic form, on the other side, it is a valuable tool used for the assessment of publication output of research particularly on the level of a researcher (publications and citations) as well as at the level of an institution and country (publications).

In the Czech Republic Web of Science was introduced on February 27, 2001 through the implementation of LI 200041 project in the framework of the Ministry of Education, Youth and Sport programme. Later, the project LI 01043 was made available the JCR (Journal Citation Reports) database which is used for the assessment of scientific periodicals. The holder of the project is the Library of the Academy of Sciences of the Czech Republic and the consortia form was selected for its financing.

Bibliometry (publication and citation analysis on the level of a country, incl. the discipline analysis) was first used in Analysis of R&D carried out in 1999. The dedicated product NSIOD attributed to the assessment on the level of a particular country, which was at that time offered by ISI, was successfully used. The periodicals were assessed by JRC on CD-ROM which was at that time available in the Library of the Academy of Sciences of the Czech Republic.

Recently, important events occurred which influenced the implementation of part D of 2002 Analysis.

- on May 4, 2001 new ISI Essential Science Indicators product was introduced based on Web which fully replaced the original NSIOD.
- on December 4, 2001 ISI introduces ISI Web of Knowledge product which is a unique sophisticated platform which links the periodicals literature, patents, chemicals and genetic sequencing and integrates proceedings and other publications and electronic sources.

At present, the offered ISI Web of Knowledge represents an integrated environment (Web of Science, Current Content Connect, Derwent Innovations Index, Proceedings, BIOSIS Previews, Chemistry, Essential Science Indicators, Journal Citation Reports and management sources e.g. ProCite, Reference Manager, EndNote) stemming from Web which undoubtedly substantially speeds the process of cognition due to the almost unbelievably high effectiveness (105 times) of work with professional scientific information. It is a tool of a strategic meaning which indicates new opportunities of monitoring of current state in science in general, and particularly in research.

ISI Essential Science Indicators which is a very powerful tool of research publication output is an integrated part of ISI Web of Knowledge. This tool helps the researchers to carry out continual quantitative analysis of research and to monitor the trends in research. It enables the scientific analysts in governmental agencies to assess the research quality (as a whole and according to the disciplines) on the level of a country, region, institution, corporation, research team and a particular researcher and enables to assess the quality of professional periodicals.

It provides valuable information on research outputs and their impact on specific disciplines of research and assesses the personnel, co-operators, opponents and reviewers potential. Thus it has become completely indispensable tool in the process of increasing the level of assessment of research activity carried on all levels and contributes to the effective management and financing of research institutions.

Negotiations on the acquisition of access of the Czech Republic to ESI will not be completed in time and therefore it was necessary to seek an alternative source of data for part D. Bibliometry.

Web of Science was used to elicit data on the number of publications on the country level, but it does not provide information of the number of citations on the given level. Therefore it was possible to carry the comparison of selected countries according to the indicators derived from the primary indicator of a number of publications (relative publications production and publications productivity). The negative feature of the selection of data on the number of publications by means of Web of Science is a choice of country name. The graphs list the Czech equivalents of English names. In case of the Czech Republic the correction was used for the purpose of dying-away of data under the name Czechoslovakia as late as 1995.

Due to the fact that Web of Science does not provide data on the number of citations on the country level, it was not possible to compare the selected countries according to the relative citation impact (RCI) indicator which indicates the measure of a bibliometric quality of a publication.

For the reasons mentioned above we applied an alternative information source which is a lecture of the business manager of ISI Thomson Scientific, Mr. Ryan Shepard, delivered on the occasion of the inauguration of the Czech Web of Science. The RCI values for the group of post-communist countries were taken from the presented graphs.

For the assessment of periodicals the access to the full-fledged JCR was used which covers scientific periodicals both from the field of natural and social sciences. Direct availability of time dependence of PIF contributes to the high effectiveness of assessment.

JCR is an annual report which serves predominantly to subjects which finance the publishing of periodicals as well as an editorial board for the stipulation of a proper editorial policy. Only those periodicals which are included in the system of qualitative assessment ISI Thomson Scientific are mentioned. It means that their PIF has a measurable value. If the PIF values drops to zero, the periodical is eliminated from the assessment but is still indexed for some time.

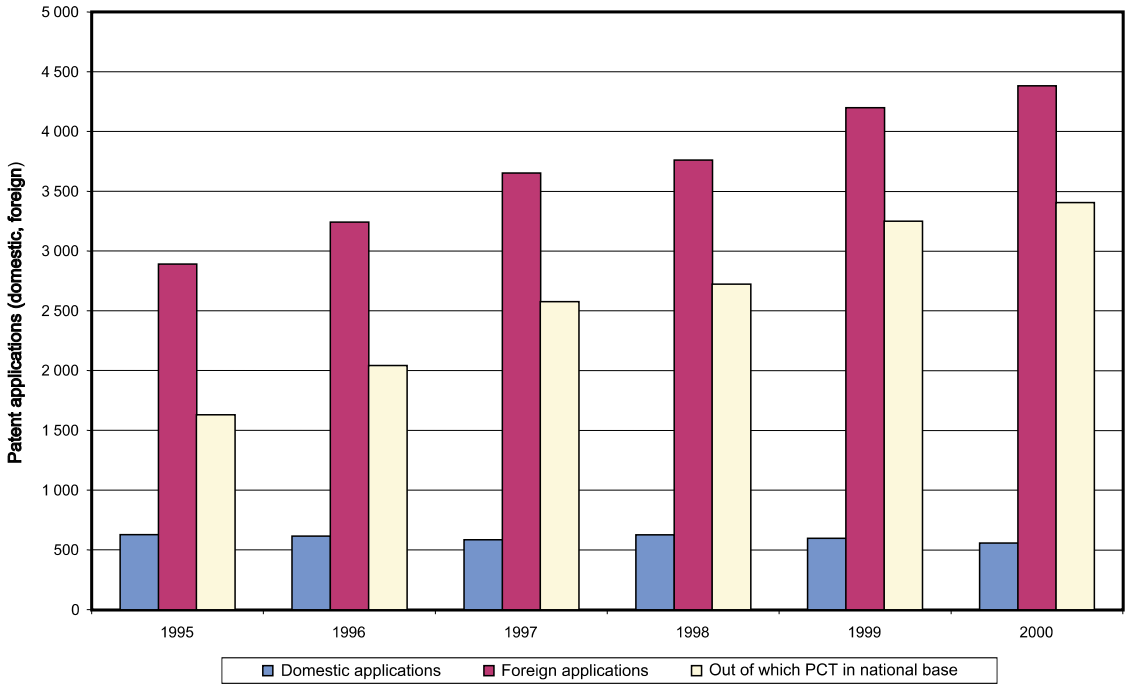
In assessing the periodicals it is necessary to get to know the title of the periodical genesis in the period longer than the period of assessment. Thus it is possible to elicit hidden information which may be used for the proper interpretation of indicators values and their time trends.

For instance, European Journal of Entomology is published in the Czech Republic and assumes a top position among Czech periodicals which retains in a long run. The reason is the fact that the entomologists agreed upon that the original Czech periodical shall change its title and shall become the most important publication forum of European entomologists.

A quite opposite situation evolved with respect to Bulletin of the Astronomical Institutes of Czechoslovakia in which the community of Czechoslovak astronomers was publishing between 1947 and 1991 and which was indexed by ISI. However, in 1992 this national periodical was linked with the European periodicals Astronomy and Astrophysics (published in Germany) which was established in 1969 by the linkage of national periodicals of Western-European periodicals. Since then Czech astronomers publish their works exclusively in this and other international scientific periodicals edited abroad. This step had a very positive impact consisting of the fact that the citation impact of Czech astronomy works published in prestigious European periodicals increased and thus increased PIF of this publication forum. The fact that the statistics lists one Czech scientific periodical less in favour of another country is not relevant for the reputation of the Czech Republic.

E 1. Patent applications filed in the Czech Republic between 1995 and 2001

(domestic and foreign patent applications, PCT designations)



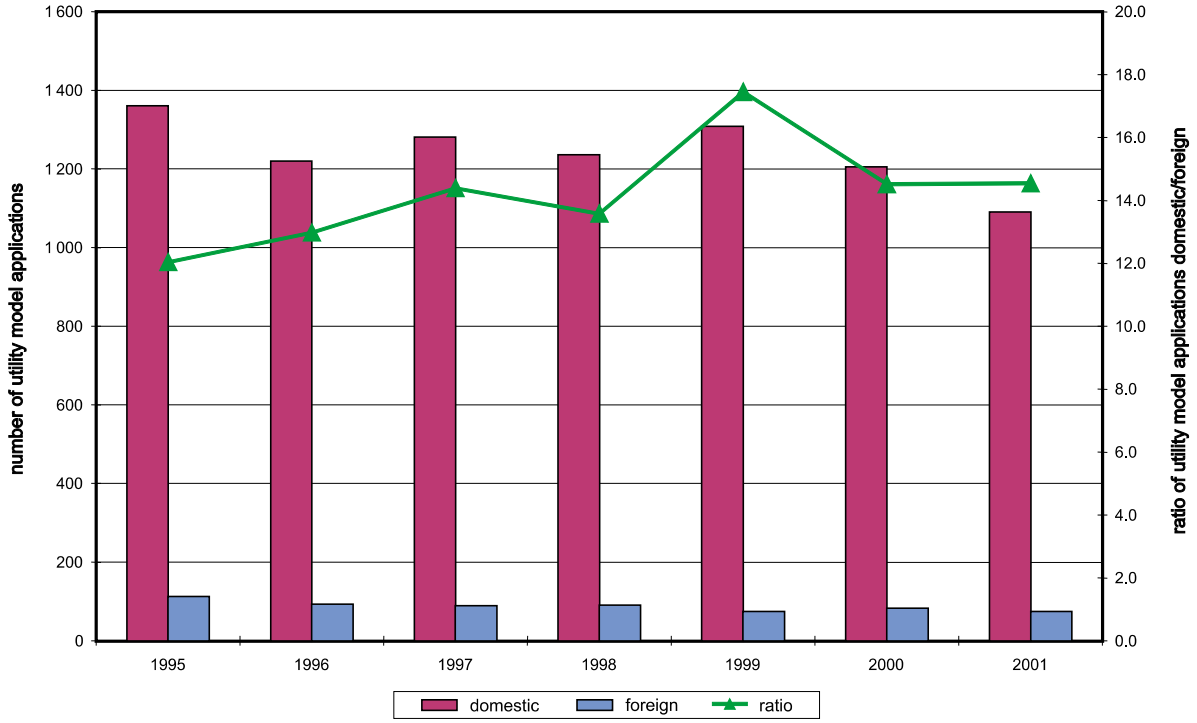
Source: Industrial Property Office
Note: Applications filed in PCT (Patent Corporation Treaty) member states in which the Czech Republic was designated by the applicant as the country in which the applicant seeks to obtain protection. The number of international applications is plotted on vertical axis.

Commentary

1. It is possible to mention that in comparison with the year 1998 the situation in filing Czech patents with a domestic priority has not changed. Differences in numbers of patent applications in individual years are very small. It is still true that the production of new patents is in the Czech Republic on a low level. Probably the influence of transformation of both industrial and resort research and development organisations still dies-away. The lack of financial means for the industrial protection cannot be the main reason of a low number of applications, the fees are relatively low in the Czech Republic.
2. Professional public has only to fully realise that a technological capacity of a particular country depends on the efficiency of a national system of innovations. Innovation activities follow from the inventions protected by patents which are more competitive on the market than the unprotected conceptions, both in direct implementation or as a licence offer.
3. Number of filed applications with a foreign priority regularly increases every year. It is a signal of interest of foreign investors to carry on business under the support of protected industrial property.
4. International patent applications PCT, where the Czech Republic is a member since 1993, enable one to apply for protection in more than one state at the same time for a reasonable fee. International search and preliminary examination are worked out centrally. The result is a preliminary test of potential success of national stage of application without search and with lower costs. Usefulness of this procedure is certified by ever increasing number of PCT applications both abroad and in the Czech Republic.

E 2. Utility model applications

(number of domestic and foreign utility models and their ratio)

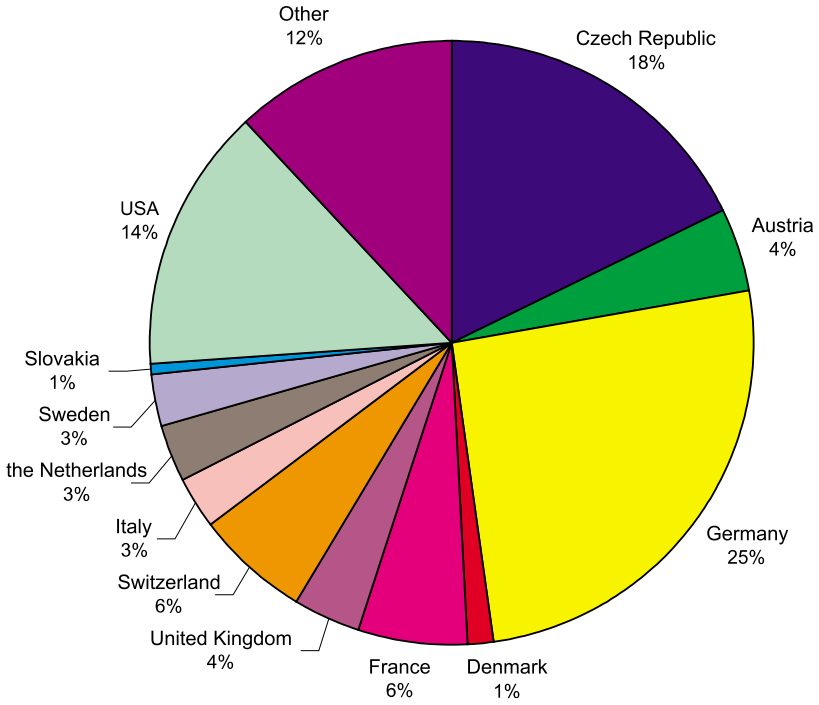


Source: Industrial Property Office
Note: The institute of utility model as a form of protection was introduced in Czechia in 1992. It is a industrially applicable technical solution exceeding the framework of a mere expertise. This protection is based on a registration principle. The procedure is simpler and cheaper but its validity is shorter. Entry into the register takes place in several months after the filing of an application.

Commentary

1. The proportion of domestic and foreign utility models applications is reverse to the patent applications. One of the reasons is a fact that the institute of a utility model is introduced only in some countries (Poland, Hungary, Slovakia, Germany, Austria, Denmark and Japan).
2. After the initial rise, the number of utility model applications has stabilised, in the last three years a slight decrease may be observed. Nevertheless the ratio between domestic patent and utility models applications in the Czech Republic is unique. Whereas in Germany the utility model applications amount to 39 %, in Denmark 25 %, in Japan 2,5 %, in Poland 56 %, in Hungary and Austria 41 %, in Czechia it amounts to 219 %! (it is similar in Slovakia – 119 %). It is possible that the easiness and availability of this form of industrial protection decreases the number of filed domestic patent applications in the Czech Republic.
3. Parallel to the introduction of EU patent considerations appeared on the introduction of EU utility model. However, this idea has no sufficient support. Critics argue that EU utility model would overburden the market with tens of thousands of monopoly rights and could undermine the generating EU patent system. Utility model is used particularly for the protection in the national framework which is demonstrated by the above-mentioned Figure.

E 3. Holders of patent rights in the Czech Republic in 2001
(residents and foreigners)



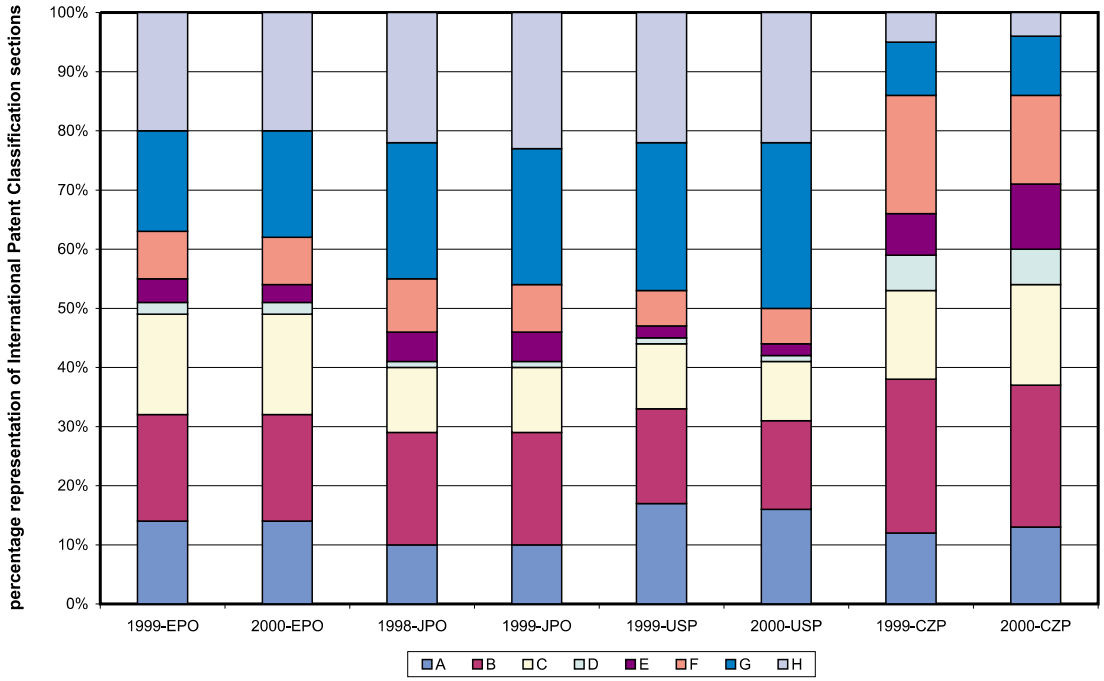
Source: Industrial Property Office
Note: For this type of analyses the data on granted patents are used, statistics of that phase of a patent proceedings when a full protection is attained and the patent may be offered for a licence, not the statistics of patent applications.

Commentary

1. Large number of foreign patent holders granted in the Czech Republic expresses the efforts of foreign subjects for the protection of industrial property in case of direct investments, export of patented products and technologies or of sale of licences into the Czech Republic.
2. In the Czech Republic economically strong neighbour – Germany – owns and controls patented technical solutions in one quarter (its share constantly grows – in 1993 it amounted to 8.9 %), developed EU countries own one half (out of Scandinavian countries Sweden amounts to 3 % a Denmark 1 %). Low representation of the United Kingdom enterprises (4 %) which probably focus their investment interests into other territories, is surprising. Swiss firms are represented here relatively substantially – 6 % (it is by 2 % more than in Austria, which is comparable pursuant to the number of inhabitants). 14 % of patent rights belongs to USA firms which is the second strongest representation following the Germany.
3. Domestic holders own only 18 %, i.e. not even one fifth of patents valid in the Czech Republic. Is it a result of ongoing globalisation, or of a decrease of creative activity of people? It is not possible to stipulate only from primary source, it would require more complex analysis.
4. The Czech Republic gradually becomes only a passive consumer of new technologies, its share on the active creation and development is very low. According to the IPTS study technological dependence reflects also in other EU candidate countries, particularly in Hungary, but also in Poland or Slovenia. In a longer time horizon foreign technological investments (particularly hi-tech) might stimulate growth of local innovations.

E 4. Patent applications by sections in large economic blocks

(percentage representation of individual sections of International Patent Classification, comparison with the Czech Republic)



Source: Industrial Property Office, Trilateral Start. Report 2000(EPO)
Note: Patent applications are classified according to individual International Patent Classification sections: Section A – agriculture, foodstufs, medicine, personal objects; Section B – technology, transport; Section C – chemistry, incl. bio-technologies, metallurgy; Section D – textile, paper; Section E – construction; Section F – mechanical engineering; Section G – physics, incl. nuclear, computers; Section H – electrical engineering, communication engineering.

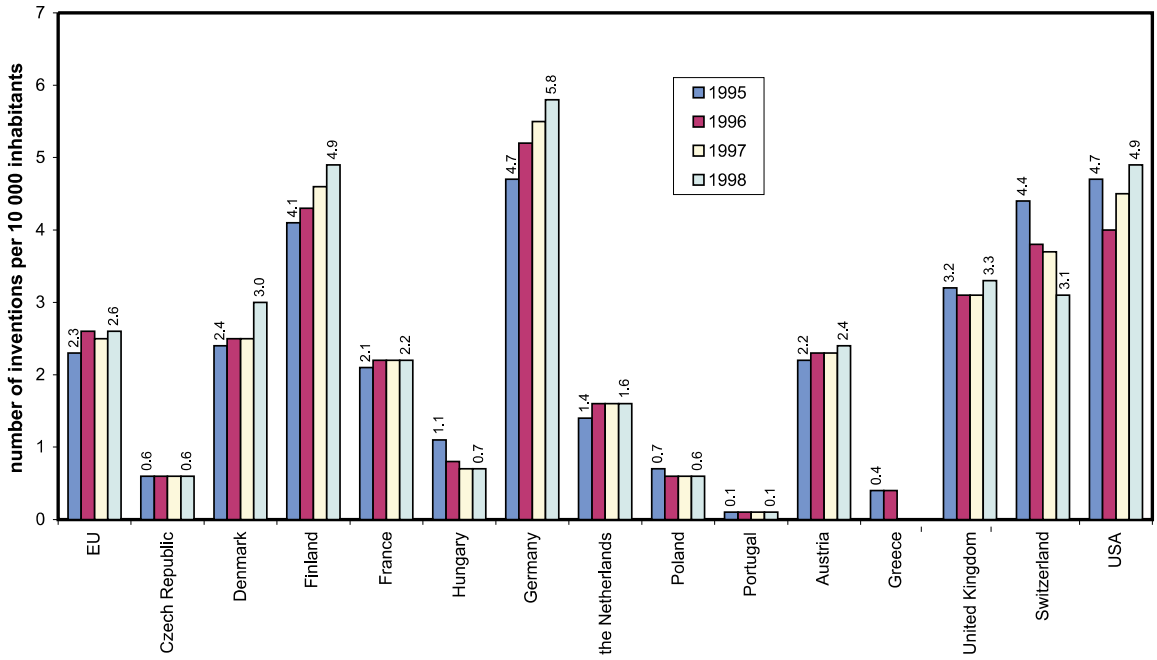
Commentary

1. Patents having domestic priority prevail in spheres which do not impose high demands on technology and knowledge, mostly in traditional sectors of our industry – heavy, mechanical engineering and chemical. Particularly the share of chemical section C substantially exceeds the percentages reported in the USA and Japan (the same is true in section D), and equals to the EU share. Substantial decrease by 5 % was recorded in section F (mechanical engineering) which is a trend heading towards the state in developed countries. Growth by 1–4 % was recorded in sections A (agriculture, foodstuffs, medicine, personal objects), E (construction) and G (physics, incl. nuclear, computers). Due to a small number of Czech patent applications (see graph E 1) it is not possible to draw conclusions from the fluctuations in particular sections by several percent, the condition may be called stagnating.
2. The structure of patent applications, filed at top world patent organisations (European Patent Organisation, patent offices of Japan and USA) evidences the stress which is laid on the solutions with a high participation of new knowledge, particularly in section G – physics and H – electrical engineering.
3. Share of the Czech Republic in section G is at the level of Spain and Italy. Pursuant to the Eurostat statistics the average annual growth in this section amounted in 1990–98 to 2.8 % in EU and 1.2 % in the USA.

4. Average share of section H on the total number of patent applications in 2000 amounted to 4 %, it decreased by 2 % since 1996. Out of the EU countries, Greece is on the same level as Czechia, with a smaller portion only in Portugal and Luxembourg. Besides low portion of Czech patents in this sphere having the most intensive R&D, the trend of the development is also negative. And this section undergoes a turbulent growth: Finland showed the portion of 40 % of the total number of its patent applications (1998). Average value in EPO is 20 %. Eurostat reports for the monitored period an average annual growth of 6.3 % in EU and 8.7 % in the USA.

E 5. Activity of inventors in selected countries between 1995 and 1998 Inventiveness coefficient (resident patent applications/10 000 population)

(inventions per ten thousand inhabitants in individual countries)



Source: OECD – Main Science and Technology Indicators 2001/1

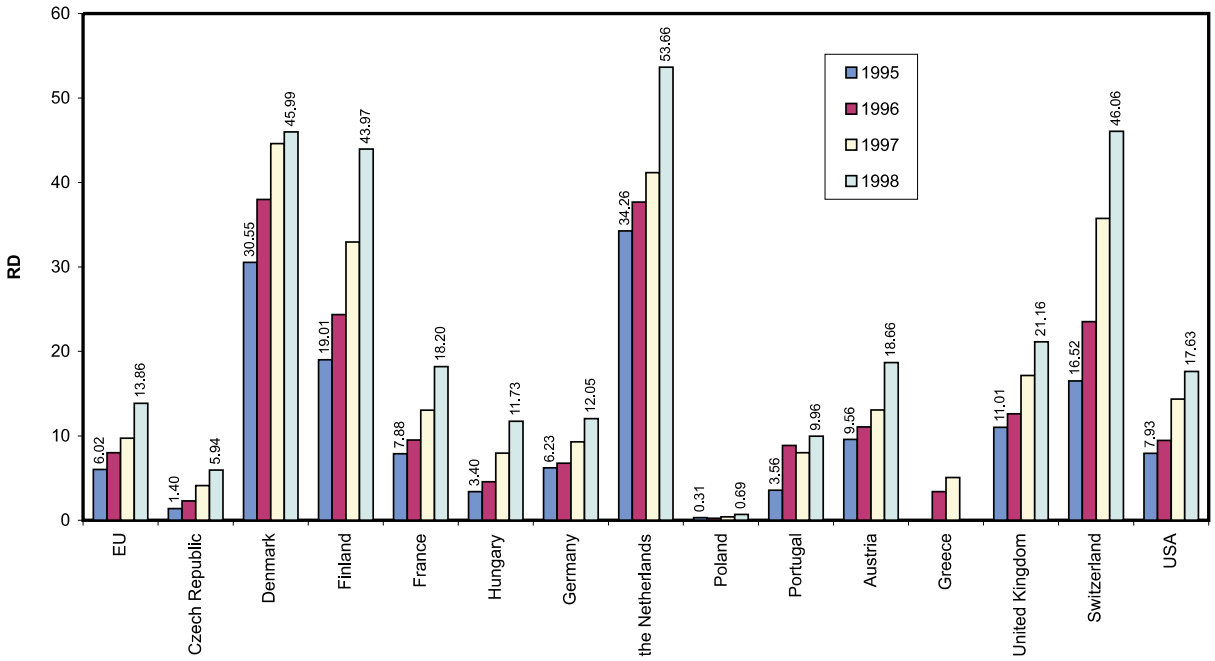
Commentary

1. Relatively high inventiveness characterising Switzerland is probably due to the prevalent private (non-state) R&D financing and the ensuing high demand for innovation and the subsequent profit. A somewhat different, so-called registration patent system might also have some influence (patent search is carried out only with some patent classes while the remaining classes are only registered).
2. The high inventors' activity in Germany is traditional and, in view of the size of the country (more than 80 mil. inhabitants), also highly beneficial to the world technical level. The same applies still more to the USA.

3. The inventors' activity in Finland is surprising and for the Czech Republic very illuminating. An extraordinarily rapid progress is deliberately based on support extended to research and development and transfer of new technologies to both industry and services. Finnish hi-tech products find their way to the most demanding markets.
4. In the Czech Republic a small number of resident patent applications stagnates (year – number of patents: 1995 – 627, 1996 – 617, 1997 – 585, 1998 – 626). This stagnation is a distinctly negative signal. A similar development prevails in Hungary and Poland.

E 6. Rate of diffusion between 1995 and 1998 Rate of diffusion (external/resident patent applications)

(indicator of rate of diffusion)



Source: OECD – Main Science and Technology Indicators 2001/1
Note: Rate of diffusion (RD) is defined as the ration between resident patent applications filed abroad and resident patent applications filed in the country of residence.

Commentary

1. It is obvious that a considerable part of patents is filed not only in the country of residence, but also abroad. In general large countries disseminate their inventions to a lesser extent than small countries of analogous innovative activity.
2. The low rate of diffusion typical of the Czech Republic is primarily due to the lack of funds necessary for filing and maintaining patents. The situation should improve after the accession of the Czech Republic into the European Patent Convention in 2002. The membership shall make the filing procedure simpler and less expensive.

E 7. Inventions, patents and innovations – overall commentary

Rapid development of science, research and technologies in the last decade of the 20th century provoked more attention to the intellectual property rights, i.e. to patents or utility models, industrial models and trademarks and in the sphere of copyright to software products. For R&D the decisive are patents for inventions. Costs on R&D have a tendency to grow simultaneously with the globalisation of economy. The meaning of intellectual property increases together with the strengthening competition, patents influence the trade strategy, business partnership, position on the market or acquisition of new capital.

Individual simple data on patent applications are not transparent enough, they do not have a deeper predicative function. Therefore secondary and cumulated indicators are used. It was transferred to the assessment of innovation activity through a total number of patent families, i.e. analogue patent applications for the same invention at the three largest patent offices: European (EPO), USA (USPTO) and Japan (JPO). They form so-called "triads". The numbers of filed patent applications in the sphere of information and communication technologies and bio-technologies are supplementary indicators. They illustrate the international technological activities and trade flows among the three large economic blocks. Patents "anchored" in this manner signalises the tendency towards a robust protection and simultaneously broad potential trade background. However, in general the interpretation of patent behaviour in the terms of economic development is difficult as it is not known yet how the economic factors influence the number of invention applications. Specific aspect of bio-technological inventions represent ethical issues of protection – it is not forbidden to patent these inventions, but the society fears the property rights "...on inventions the commercial use of which would contravene the public order or good manners, particularly on the cloning of human beings, ways of modification of gene line of genetic identity of human beings...".

Intensity of inventions patenting is in the Czech Republic in comparison with the results of analysis of 1993–1996 still very low and stagnate. Besides the dying-away of privatisation and transformation a certain aversion of researchers against the patent proceedings, which they find complicated and financially demanding (which is not true in regard to the resident protection), low motivation of R&D workplaces to co-operate with industry and services as well as not fully optimal conditions of SME (small and medium enterprises) for carrying on business, must be considered. Also the overall effectiveness of costs on science and research from the point of view of patenting is relatively low in the Czech Republic. For instance, in the framework of OECD Czechia represents by 0.32 % on the amount of expenditures on R&D from the state budget, in the number of patent applications we participate only by 0.05 % (applications to EPO in 1997). With respect to the above-mentioned "triads" – top inventions in hi-tech technologies – Czech inventions represent the value of 0.02 %.

To complete the analysis a set of patents with primary Czech priority between 1993 and 2001 cited by other patents was elaborated from a newly accessible Derwent WPI database (Citing + Cited Accession Number Count). It has resulted in 68 cited patents none of which belonged to the hi-tech sections of technological development. It means that the influence of supporting knowledge of our production limits to traditional sectors of consumer industry – mechanical engineering, textile industry and chemistry. This conclusion certify also the given data (see chapter E 4).

Act on the research and development support might improve this situation. It considers the application fees on inventions as recognised costs in the framework of institutional and specific support of R&D. It shall facilitate the non-profit-making research organisations and SME an easier access to patent protection.

Internationalisation and globalisation world-wide pressures upon the harmonisation of national patent systems, simplification and costs reduction of a process of patent granting. The European Parliament proposes to reduce the application fees for SME, or as a case may be, for universities and non-profit-making research organisations, by means of which it strives to broaden the availability of patent protection in EU. Also the diversification of protection period among individual technological spheres is under consideration. At present this period is 20 years except in pharmacy.

The fruitfulness, i.e. effective implementation of inventions is in Europe in general lower than in the USA or Japan. European research institutions including universities excel in the creation of inventions, not in their implementation ("patent deficit"). In the USA the intensification of patent system support resulted in so-called pro-patent era, which caused the above-mentioned fast increase of number of patents, particularly in the sphere of information and biological technologies. An example of a massive support of patenting in the USA may be the so-called protective term of novelty, which enables to file an application for a patent as late as a year after it was published. This possibility which allegedly increases the number of patent applications by 20 %, is also being considered in Europe. Efficient, simple and cheap patent system is an economic must for the European countries (not only EU). Endeavours to unify the patent law in Europe resulted as early as 1973 into the European Patent Convention (EPC). The aim of this convention is to overcome the limitations of national patent systems and simplification of patent application abroad. European patent is sometimes characterised as a bond of national patents: on the basis of one European application following one joint search proceedings the applicant may ask for the granting of a patent simultaneously in all contracting parties pursuant to his/her own choice. All European countries are members of EPC. Another, broadly implemented system of international patent protection is the Patent Cooperation Treaty (PCT) under the auspices of the World Intellectual Property Organisation (WIPO, formerly BIRPI) and signed in 1970. The Czech Republic acceded to the treaty in 1993 and its membership has already been recorded in statistics (see graph E 1).

Attempts to introduce the EU Patent continue to be made. At present the proposal for the elaboration of unified and autonomous patent valid on the whole territory of the EU was published: the granting, transfer or extinction shall be possible only for the EU as a whole. However, this conception shall require the revision of EPC and a number of legal and administrative amendments.

The Czech Republic acceded to the European Patent Convention on July 1, 2002. It is a further step towards the integration into the EU, the harmonisation of national patent law with the Community law on the protection of industrial property shall carry forward. Legal environment shall be more favourable for business and shall become transparent. The inventors shall be able to use the advantages of membership among member states, i.e. to file the patent applications in the national language, to use the reductions of official fees and to negotiate with the European Patent Office without expensive foreign patent representative. The above-mentioned advantages should result in the increase of a number of EP applications of Czech inventors. It is also expected that the foreign patent applications with effects for the Czech Republic shall substantially increase which might have a positive impact upon the foreign investments in the Czech Republic although it shall simultaneously increase the competition presses upon Czech industry. However, these steps seem to be a good preparation of both Czech R&D and economy for the admission into the EU.